Municipal and County Engineering

DESIGN, CONSTRUCTION, OPERATION AND MAINTENANCE OF ALL PUBLIC WORKS

Vol. LXIX. JULY, 1925 No. 1

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Contracts Awarded

ROADS AND STREETS

Ala., Birmingham—Federal Asphalt Paving Co. and C. Browne, award. contracts by City Commission to pave 5 streets and lay sidewalks, construct curb, gutters, etc., on one street, at total cost of $102,000.

Ala., Montgomery—State Highway Commission, Montgomery, let contracts for 4 roads: Houston and Geneva Counties, 20.70 mi. sand clay betw. Dothan and Hartford, to J. E. Speight, Florala; Lamar Co., 12 miles gravel betw. Guin and Sullikent, to Nixon & Phillips, Birmingham, at $158,048; S. J. Cummings, Gadsden, contr. for bridges; Pickens Co., 10.6 miles gravel betw. Carrolton and Aliceville to Fennell & Toothacher, Tuscoloosa, at $103,688; Bullock Co., 8 miles gravel betw. Union Springs and Fort Davis to D. Andrews, Americus, Ga., at $88,412.

Cal., Los Angeles—Kuhn Bros., 408 Centre St., Manhattan Beach, awarded contract by County at $119,880 for impvt. of Whittier Blvd. betw. east City limits of Montebello and Philadelphia St., Whittier; 3.12 miles (no. half of rd.).

Cal., Los Angeles—W. J. Curren, 221 W. Broadway, Glendale, contract for impvt. of Del Mar Ave.—Valley Blvd. to Garvey Ave., at $127,871; O. U. Miracle, 227 Ave. D., Redondo Beach, contr. at $55,140.23 for impvt. of Meyler St.—36th to 37th Sts.; Warren Constr. Co., 2221 E. 25th St., awarded contract at $26,596 for impvt. of Beachwood Dr.—412 ft. so. from Sunset Blvd. to Santa Monica Blvd.

Cal., Oakland—Oakland Paving Co., 5000 Broadway, Oakland, awarded contract by City to pave E. 14th St.—50th Ave. to so. City line and 94th St. from E. 14th to A Sts., at $499,041.

Cal., Sacramento—Irey & Holden, Lodi, awarded contract by State Highway Department at $42,671.50 for constr. of section of State hwy. in El Dorado Co. betw. Camino and 2 miles east of Sportsman's Hall; about 5.8 miles long, to be graded and portions surfaced with crushed gravel or stone; Federal Paving Co., San Francisco, awarded contract for constr. of section of State hwy. Kern Co. betw. Beardsley Canal and Lerde; abt. 8.2 miles in length, to be widened with asphalt conc. shoulders and surf. with asphalt, at $137,698.50.

Cal., Sacramento—Following contracts let for highway work in State: Basich Bros. Co., 3788 Vermont Ave., Los Angeles, at $119,879.70 for highway in San Bernardino Co. betw. Santa Ana Riv. and Redlands; abt. 5.5 miles. 3 miles are to be paved with cem. conc. and 2.5 mi. widened with cement concrete shoulders and surfaced with asphalt concrete; R. A. Wattson, 1026 McCadden Pl., Los Angeles, contract for highway in San Diego Co.—San Onofre to west boundary, 3.65 miles cem. conc. pave., at $119,057.40.

Conn., Hartford—J. A. McDonald, Commr., State Hwy. Dept., Hartford, let following contracts: Bitum. mac. surf., 45,394 ft. on Northampton Turnpike in Windsor, Windsor Locks, E. Granby & Suffield, to Lane Constr. Co., 37 Colony St., Meriden, at $168,134; 13,144 ft. Hebron Ave., in Glastonbury to F. Arrigoni & Sons, Middletown, at $26,600; waterbound macadam surf., 20,785 ft. Raymond Hill Rd. in Montville to D. Arrigoni, at $102,933; 19,980 ft. Colchester Amston rd. Colchester and Hebron, to L. Suzio Constr. Co., State and Brooks Sts., Meriden, at $83,234; 6,000 ft. Macedonia Rd. in Kent to W. J. Montgomery Co., 72 Conner St., New Haven, at $58,368; 12,900 ft. Brantford and No. Brantford rds. in Brantford and No. Brantford to Kelleher Bros., Montague City, Mass., at $52,956, and 6,000 ft. Georgetown Rd., in Redding, to Osbon & Barnes Co., Odd Fellows Bldg., Danbury, at $47,354—Total, $539,579.

Fla., St. Petersburg—Davis, Miller & Cobb, Tampa, awarded contr. at about $234,000 to widen ¼ mile Lakeview Ave., from 16 to 40 ft. and pave with asphalt block, 5-in. rock base and asphalt filler.

Fla., Tampa—Highway Engineering & Constr. Co., Shelbyville, Del., awarded contract to pave 12 streets at about $240,000 in Sunset Pk.; Cone Bros., Caesar & Walton Sts., at $15,000 to pave 2nd Ave.—Bayshore Blvd. to Hills Ave.; Union Paving Co., Tampa, at $35,000 to pave Manhattan Ave.—Memorial Hwy. to Cypress St.

Fla., Lake City—C. F. Lytle Co., Jacksonville, awarded contract for abt. 8 miles conc. paving here, at $244,000.

Fla., Sarasota—J. W. Crawford, awarded contract to pave 20 streets and alleys; about 64,000 sq. yds. Contract price, $180,186.

Fla., Tavares—Southern Paving Co., Volunteer Life Bldg., Chattanooga, Tenn., awarded contract for hwy. from Leesburg to Helena Run and to Wm. B. Gibson, Lady Lake to grade; approx. cost, $44,000 per mile.

Ga., East Point—Following contracts for 6 roads and 5 brdgs. let by State Hwy. Department: Elbert Co., 8½ miles topsoil to Wallace Construction Co., Atlanta, at $77,124; 3 bridges to E. M. William, Monroe, Ga., at $16,316; both awards subject to approval of Elbert County Bond Comn.; Charlton Co., 10 mi. surface treatment betw. Waycross and Jacksonville to Sam E. Finley, North Ave., Atlanta, at $34,818; Clarke Co., resurfacing 4½ miles penetration macadam betw. Athens and Bogart, to Sam E. Finley, at $13,757; Gilmer Co., 3¾ miles macadam betw. Ellijay and Jasper to R. L. Killian, Canton, Ga., $60,064; 2 brdgs. to Sims & Clouts, La Fayette, at $19,241; Rockdale Co., 9 miles topsoil, Atlanta-Convers-Covington hwy. to Wallace Constr. Co., at $64,422; Cobb and Fulton Cos., surf. treat ½ mile hard surf. rd. betw. Atlanta and Roswell. Sam E. Finley.

Ill., Springfield—Following contracts let by State Highway Comn.: Sec. 15X, Winnebago Co., paving to Verhey Constr. Co., Urbana, at $8,957; Sec. 11, Cook Co., paving to Chicago Heights Coal Co., Chicago Hts., Ill., at $133.532; Sec. 3V, Jackson Co. brdg. to Wm. Lough & Son, Marion, Ill., at $14,660; Sec. 11B, Cook Co., bridge to Medaris-Barnett Co., Greenfield, Ill., at $27,222.70; Sec. 18B, Fulton Co., bridge to M. R. Deyo, Peoria, Ill., at $69,905; Sec. 11B, Carroll-JoDaviess Co., brdg. to Chernus Construction Co., Minneapolis, Minn., at $49,846; Sec. 1, Lawrence Co., paving to French Constr. Co., Fairfield, Ill., $121,704.

Ky., Frankfort—Costello Bros., Knoxville, Tenn., awarded contract for F A 131 B, 6.997 miles G & D, Bardwell-Clinton Rd., at $62,622; Fulton Co., Fulton-Hickman Rd., F A 131 B & C, 6.087 miles G & D, to same contractors, at $54,590.

Me., Augusta—Wyman & Simpson, Waterville, awarded contr. by State Hwy. Comn., for gravel surfacing 3.32 miles of highway; F A P 64 in New Sharon, at $51,919; bitum. macadam pav. 2.03 miles hwy. in Houlton and gravel surf. 5.26 miles hwy. in Livermore, to Boone & Brewer Constr. Co., Presque Isle, at $60,797 and $88,729, respectively; bitum. macadam pave. 4.3 miles hwy. in Gray, to A. D. Bridges & Sons, Inc., Hazardville, Conn., at $90,947.

Mich., Adiran—W. L. Johnson Constr. Co., Hicksville, Ohio, awarded contract to build 6¾ miles bitum. macadam road betw. Adrian and Wellsville, $114,728.

Md., Baltimore—Arundel Construction Co., Knickerbocker Bldg., awarded contract by Board of Estimates to pave sections of West, Bath, Monument and Durham Sts., at $31,375; American Paving & Contracting Co., Montebello Ave. and B. & O. R. R., at $86,939 for sections of Aisquith, 20 and Taylor Sts.

Mich., Lansing—Following contracts let week ending June 11, by State Hwy. Dept.: No. 12-28, B, Gogebic Co., Wakefield Twp. Cl. 7-in. F-Pl. 20 ft. wide, 0.018 miles, to Thor. Hoseid, Wakefield, at $2,271.94 (est. cost cement, $533.60); 10-3, D, Arenac Co., Vil. of Omer, Cl. G & DS, 0.331 mi. to J. A. Campbell, Bay City, Mich., at $4,125 40;

Rd. 10-39 C and D-2, Oakland Co., Royal Oak Twp. Cl. 9-in. F-Pl. 40 ft. wide, 3.453 mi. to R. D. Baker Co., Detroit, Mich., at $241,311.86 (est. cost cement, $83,443.38); 10-39, A-2, Oakland Co., Bloomfield Twp. Cl. 9-in. F-Pl. 40 ft. wide, 5.516 mi. to White Constr. Co., Chicago, Ill., at $277,247 (est. cost cement, $113,729.63); 10-39, B-2, Oakland Co., Troy and Royal Oak Twps. Cl. 9-in. F-Pl., 20 ft. wide, 4.20 miles to W. H. Knapp Co., Monroe, Mich., at $140,993.28.

St. Louis, Mo.—Granite Bituminous Paving Co., Ry. Ex. Bldg., Bridges Asphalt Mfg. Co., Central Paving & Constr. Co., 6161 Maple, Webb-Boone Paving Co., awarded contracts by Board of Public Service to pave and rebuild 8 streets here, at $400,626.

Neb., Holdredge—Roberts Constr. Co., 405 1st Natl., Lincoln, awarded contract for paving, grad., curb and gutter in Paving Dist. 13, 14 and 15, at about $109,365.

N. H., Concord—Following contracts let by State Hwy. Comn.: Graveling 0.76 miles highway in Randolph and 0.83 miles in Colebrook, to T. Melloy, Gorham, at $13,555 and $15,290 respectively; 0.71 miles hwy. in Newbury to Peckman Rd. Corp., Farmington, at $8,387; rein. conc. surf. 1.63 miles highway in Concord, to Winslow & Cummings, Nashua, at $52.280; bituminous macadam pav., 0.57 miles hwy. in Dorchester, to Robie Constr. Co., 1037 Elm St., Manchester, at $12,811 and 0.8 miles in Bethlehem, to O. W. Fernwald, Berlin, at $12,328; modified asphalt pavement, 1.86 miles hwy. in Boscawen to A. D. Bridges Sons, Hazardville, Conn., at $23,706.

N. J., Elizabeth—J. B. Gilligan, Casey Co., 972 Broad St., Newark, awarded contract for paving 2 streets, at $91,651; Gilligan, Barrett, Cahill Co., Broad St., Newark, at $197,577. Paving Bway to Standard Bitulithic Co., Brill St., Newark, at $85,189.

N. Y., Long Isl. City—W. P. MacDonald Constr. Co., 342 Madison Ave., New York City, awarded contract for grading and repairing W. Allen road, at $149,430.

N. Y., New York—Asphalt Constr. Co., 208 Broadway, awarded contract for sheet asphalt paving on 135th St., at $104,904; granite block repaving Canal St. to J. Meehan & Son, 74 Cortlandt St., at $54,976.

N. Y., New York—Pres. Bronx Boro., H. Bruckner, let following contracts: Bitum. conc. pav. Mt. Eden Ave. and granite block. repaving E. 149th St., to Asphalt Constr. Co., 208 Broadway, at $14,962 and $211,706, respectively; granite and asphalt blk. repaving Fordham Rd. to Regan Towers Co., 124 W. 121st St., at $179,104; grading, etc., Adams St., to M. Del Balso, 660 E. 221st St., at $3,391, Calhoun Ave. to Spadaro Contg. Co., Inc., 375 E. Fordham Rd., at $10,788; Bogart Ave. to S. Nugent, 285 W. 150th St., at $10,983.

N. C., Raleigh—State Hwy. Comn., Raleigh, let contracts for 11 roads: Beaufort County: 8.92 mi. grading to Nello L. Teer, Geer Bldg., Durham, at $53,662; Edgecombe Co.: 11.99 mi. paving to Zeigler Bros., Greensboro, at $142,681; structs., to Sparling Constr. Co., Nashville, Tenn., at $42,877; Jones Co.: 7.85 mi. paving to David Schoentag, Inc., Saugerties, N. Y., at $328,554; Chatham Co.: 18.20 mi. grading to McDowell Constr. Co., Marion, at $142,681; J. S. Bowers, Whiteville, $47,526, struct.; Vance Co.:: 5.82 mi. paving, to Coastal Constr. Co., at $182,423; Wilkes Co.: 2.17 mi. paving to Foster Constr. Co., at $76,052; J. L. Brinkley, structs., at $19,816; Avery Co.: 4.22 mi. grading to Albert Bros., Shawsville, Va., at $35,778, B. G. Young, Johnson City, Tenn., at $9,594, structs. Burke Co.: 11.83 mi. grading to Albert Bros., at $60,020, McDowell Constr. Co., $19,816, structs.; 5.24 mi. Rte. 10, to Albert Bros., at $32,213, R. C. Stevens, struct., at $9,065; Henderson Co.: 5.50 mi. paving to Wilson Constr. Co., $154,943; Carolina Constr. Co., $13,872, structs.; Buncombe Co.: 2.86 mi. paving to R. C. Stevens, at $115,677; E. A. Wood & Co., at $23,680 for structs.

Okla., Okla. City—State Hwy. Comn., Okla. City, let contracts for 12 roads and bridges: Love Co., 86.081 mi. thru Thackerville, Flynn Constr. Co., $127,089; Logan Co., grade and draing. structs. on 12½ mi. T-K-O Hwy. M. A. Swatek & Co., 519½ W. Main St., Okla. City, at $72,015; Okfuskee Co., .195 mi. grading and drainage structs. on county's part of Weleetka-Wetumpka Rd., J. E. Smith & Sons, $36,305; Hughes Co. grading and draing. structs. on County's part of same rd., W. T. Pharoah, $21,247; Stephens Co. 9.437 mi. grading and drainage structs. J. E. Smith & Sons, $35,543; also brdg. Woodward Constr. Co., $7,695; Nowata Co. 5 mi. grading and draing. Armstrong, Turner & Spaulding, Inita, at $16,411; W. F. Froebe, 2335 S. 13th St., Muskogee, $12,839 for brdg., Wagoner Co. 4 miles gravel, so of Wagoner, Ellis & Lewis, $26,355; Okfuskee Co. 1.5 mi. conc. in Weleetka, Wilson & Bush, $5,910; brdg. so. of Nowata, Kansas City Bridge Co., rear Leslie Bldg., Kansas City, Mo., $9,207; Adair Co. over Barron Fork and over Duncan Creek, Pioneer Constr. Co., $34,290; 2 brdgs. over Evansville Crk., Leroy Johnston, at $20,879.

Tenn., Jackson—Southern Paving & Constr. Co., Vol. Life Bldg., Chattanooga, Tenn., awarded contract for 43,000 sq. yds. concrete and asphalt surfaced streets, at about $149,000.

Tex., Boston—Tibbetts Construction Co., Joseph Bldg., Ft. Worth, awarded contract for 8.66 miles 18-ft. concrete on State Hwy. 48, at $297,162; concrete; State Hwy. 48.

Tex., Childress—Jordan Constr. Co., Plainview, awarded contr. at about $250,000 to pave 60 or 70 blks. in residential section, with brick on 4-in. concrete base; asphalt-filled.

Wash., Seattle—Loveberry & Watson, awarded contract for grading 12th Ave., so et al., at $195,686; Magnus Espeland, contract for grading, etc., on Holly St., at $7,067; alley blk 2, Montlake Pk. Addn. to C. L. Creelman, at $4,900.

Wis., Madison—Following contracts let for paving: J. F. Ick, Washington Bldg., rein. conc. pavement on W. Wilson, at $53,500; on Spaight St., $66,500; Fox Ave., $5,750; Main St., $8,400; Mason St., $4,900. O'Dea & Schafer, Gen. Del., contract for paving on Chadbourne Ave., at $3,150; Prospect Ave., $3,700; N. Quinn, 315 W. Johnson St., paving on St. Paul Ave. and 2nd St., at $9,560—all Madison. Total cost of impvts., $155,460.

Wis., Madison—Peppard-Burrell & Lynch, Minneapolis, Minn., awarded contract by Wis. Hwy. Comn., for grading and surfacing Manitowoc-Sheboygan Rd. F A P 420A, at $21,164 for 37,793 c.y. earth excav., at $94,884 for 83,969 sq. yds. conc. surf., total $150,560.

SEWERAGE AND SEWAGE TREATMENT

Cal., Los Angeles—G. W. Kemper, P. O. Box 126, Alhambra, award. contract for storm drains in Los Feliz Blvd. and Gleneden St., at $98,998.

Cal., North Sacramento—Chambers & DeGolyer, Bacon Bldg., Oakland, awarded contract for 62,700 lin. ft. 6 to 15-inch vitr. sewers in various streets, at $54,975.

Ont., Ford City—Chick Contracting Co., McDougall Ave., Windsor, awarded contract for sewers in various streets, at $140,000; outlet sewer to Merlo, Merlo & Ray, Ford City at $43,000.

Fla., Tampa—Bryan & Co., Phelps Street, Jacksonville, contract for san. sewers in Sec. 11, Seminole Hts., at $59,040; Sec. 13, $39,081; Secs. 14 and 17, at $25,340; Erler Corp., Tampa, Sec. 12, $69,509—total, $192,970.

Ill., Centralia—J. Webb Jones, Benton, awarded contract for san. sewer dist. No. 2 to Jas. Boaz, Leroy, Ill., at $98,267.

Ill., De Pue—P. Di Paolo, 1074 West Taylor St., Chicago, awarded contract for approx. 5 miles sanitary sewers in various streets, and constr. of disposal plant, at abt. $39,756.

Ill., Springfield—Hanson & Willadsen Co., Omaha, Neb., awarded contract for San. Dist., Sec. A, sanitary intercepting sewer project, at $272,242.

Md., Baltimore—P. Marocco, 638 S. Linwood Ave., awarded contr. by Bd. of Awards for storm sewers in Dist. G-11, 46-B, P-8 and P-4, St. Water Contr. 83, at $137,238.

Md., Baltimore—F. Angelozzi, 238 Albemarble St., awarded contract by Bd. of Awards, for storm sewers in Dist. J-8, at $196,295.

Md., Salisbury—Walter Martin, Albert Lea, Minn., awarded contract for constructing no. and so side trunk san. sewers, at $75,706.

Mass., Boston—A. Grande, awarded contract for sewerage wks. in Sunset Hill Rd., West Roxbury, at $10,271; works in Sturgis Rd. West Roxbury, at $2,747. C. Iacozza awarded contract for sewerage works in Arborway, West Roxbury, at $2,664; C. & R. Constr. Co., contract for bldg. Dorchester brook sewer, Roxbury, at $73,441; V. Barletta, awarded contract for sewerage works in Kilmarnock St., at $22,275; M. De Sisto Co. awarded contract for sewerage wks. in River St., at $2,729; Zoppo & Civitarese, awarded contract for sewerage works in Verrill St.—Norton to Woolson Sts. —Dorchester, at $2,875; A. Cefalo awarded contract for sewerage works in Western Ave., Brighton, at $19,015.

Mich., Saginaw—Wm. Eddy & Son, Wm. Carlson and Webster Constr. Co., Detroit, awarded contracts for 38 sewers. Latter concern will do most of the work.

Mich., Springwells—T. D. Nolan, 11341 Woodward Ave., Detroit, contract for 8,349 ft. 10-in. and 429 ft. 12-in. vitr. tile sewer in Sewer 44, at $17,548; 721 ft. 6-in. and 423 ft. 12-in. vitr. sewers in Sewer Dist. 57, at $840; Coolsaet Bros., 12734 Mich. Ave., Detroit, 1,533 ft. 12-in., 310 ft. 18-in., 2,332 ft. 21-in., 2,980 ft. 24-in., 2,022 ft. 27-in. and 1,005 ft. 30-in. vitr. tile sewer in Sewer Dist. 58, at $38,398.

Minn., St. Paul—O'Neil & Preston, 608 Exchange Bank Bldg., awadred contract for constr. of Belt Line outfall sewer, Contr. G; 3,808 ft. 9-in. and 1,580 ft. 24-ft. circular sewer, etc., at $242,000.

Minn., Winona—Jno. L. Hegard, Winona, awarded contract for constr. of storm sewers on Harriet, Main and Kansas Sts.; approx. 7,208 lin. ft. 12-in. pipe; 12 manholes; 45 inlets and 8 catch basins, at $32,484.

N. Y., New York—C. W. McDonald, 1910 Webster Ave., awarded contract for sewers, etc., in Cornell Ave., at $538,166; E. 242nd St., to Spadaro and Turiano, 3185 E. Tremont Ave., at $4,718 (Bronx Borough).

Ohio, Canton—Garaux Bros., Massillon Rd., awarded contract for san. and storm water sewers in ten streets in subdivision, New Avondale Addn. to City; Engineer's est., $150,000.

Ohio, Cleveland—Gantose Constr. Co., 4816 Brookpark Rd., award. contract by Bd. Park Commrs., Met. Park Dist., for 1,500 ft. 4x112½ concrete conduit in Big Creek Parkway, at $39,415. Lane & Freeman, 5713 Euclid Ave., awarded contract for sewage plant, Imhoff tanks, sand filters, sludge beds east of Bonnyview Rd., Impvt. 302, Sec. B, at $44,235; 1,500 ft. 12 and 48-in. tile brick and sewer in S. O. M. Center Rd., Impvt. 301, Sec. A, to Iafornaro & Son, 2258 Murray Hill Rd., $54,476. Sprague & Burkhardt, 11812 Browning Ave., awarded contract by City for 1,100 ft. 12-in. vitr. tile sewer in Columbine Ave., at $3,237; Iafornaro & Son, 2218 Murray Hill Rd., contr. for 840 ft. 12-in. vit. tile sewer in Kuhlman Ave., at $3,275; 1,100 ft. 12-in. vit. tile sewer in W. 150th St. and 830 ft. 12-in. vitr. tile sewer in Warren St.; also 440 ft. 2-ft. 6-in. conc. sewer in Rosemary St. to Hadded & Kariel Constr. Co., Huron-Sixth Bldg., at $3,960 and $13,018, respectively; 1,010 ft. 12-24 inch vitr. tile sewer in W. 151st. St. to E. P. Langahan, Marshall Bldg., at $4,155.

Ohio, Cleveland Heights—(Postoffice, Warrensville)—Iafornaro & Son, 2280 Murray Hill Rd., Cleveland, awarded contract for vitr. clay sewers and cast-iron water mains in 4 streets, at $65,798.

Ohio, Euclid—C. W. Jackson, 1318 E. 48th St., Cleveland, awarded contract for 8,030 ft. 36-48 inch brick sewer in Cut Road, at $96,700.

Pa., Pittsburgh—R. D. Thomas, 333 Bouquet St., awarded contract by City for 6,418 ft. 42 in. reinf. conc. and 302 ft. 15-in. sewer in Saw Mill Run Drainage Basin, at $121,000.

Pa., Pittsburgh—M. Manella, 5140 Breedshill Ave., awarded contract by City for 1,900 ft. 42-in. and 3,912 ft. 39-in. rein. conc. sewer in City line so. of Edgebrook Ave. to Pier Prop. point 400 ft. no. of West Liberty Ave. (Saw Mill Run Basin). Contr. 5, at $670,045.

Tex., Edinburgh—W. I. Pearson & Co. awarded contract for constructing approx. 6 miles sewer mains, at $70,000.

Tex., Houston—Following contracts let by City: Settling tank for Scott Street water plant let to A. M. Arnold, Scanlon Bldg., Houston, at $16,500; 2 wells, 200 g.p.m. capy., to Layne-Texas Co., 1111 Sixth St., at $55,500; 2 pumps to H. A. Payne, Houston, at $5,500.

Tex., Houston—W. T. Carter Lumber & Bldg. Co., 1201 Capital St., awarded contract to Charles K. Horton, 2202 Clay St., Houston, for 12½ miles sanitary sewers, at about $75,000; will install pumps and motors and treatment plant.

Wash., Centralia—J. F. Shay Co., Portland, awarded contract by City Comn., for constr. of new sewer and treating plant to serve west and no. west sections of City. Contract price for sewer is $62,585 and for treating plant, $12,075.

Wis., Madison—N. Quinn, 515 West Johnson St., awarded contract for storm sewers in University Ave., at $78,800.

Wis., Milwaukee—Wenzel Henoch Co., 498 27th St., awarded contract for Menominee Valley sewer extension; approx. 1.5 miles 18 and 24-in. terra cotta pipe, at $124,877.

WATER SUPPLY AND PURIFICATION

Cal., Elsinore—Claude Fisher Construction Co. awarded contract for constr. of water works system here, at $131,000.

Cal., Pasadena—Grinnell Co., 520 Mateo St., awarded contr. for cast iron pipe and fittings involving 12,000 ft. 4-in., 8-in., 12-in. and 6-in., at $75,325; Reliable Iron Fdy. Co., contract for fittings as follows: 2 tons 4-in., at $100 ton; 27 tons of 6-in. to 12-in., at $100 ton, total $2,900.

Ont., Peterboro—F. R. Wilford Co., Lindsay, awarded contract for pipe line across Otonabee River, pumping station, grit chambers, aeration tanks, settling tanks, etc., at $78,000; 3 sewage pumping units, to Smart Turner Mach. Co., $11,000; 3 complete compressor units to Francis Hankin Co., 386 King St., West, Toronto, at $18,753; air distribution, piping, etc., to W. R. Turner, Peterboro, at $14,576.

B. C., Vancouver — Vancouver Engineering Works, 519 Sixth Ave., awarded contract for approx. 14 miles steel pipe line involving about 6,000 tons steel pipe, at $500,323.

Quincy, Ill.—Priester Constr. Co., Kahl Bldg., Davenport, Iowa, awarded contract for rein. conc. high reservoir; concrete covered, at $174,578.

Ill., West Frankfort—The Katz Construction Co., 1817 Douglas St., Omaha, Neb., awarded contract for construction of water plant at about $550,000.

Ill., White Hall—C. M. Hanes, Jerseyville, awarded contract for raising present dam and spillway, diversion dam and spillway, raw water, pump house, conc. coagulation basin, brick filter bldg., filter and pumping equipt., at $54,390.

Ind., Anderson—Westinghouse Co., East Pittsburgh, Pa., contract by City for new turbine engine and appurtenances, at $118,000.

Mass., Lawrence—P. J. Holland, 24 Ames St., awarded contract by Morris Knowles, Inc., Pittsburgh, Pa., for sand filter and Water Street pumping station; engineer's est., $275,000.

Mo., Ash Grove—Sewell Well Co., 901 Howard St., St. Louis, awarded contract for well here; W. F. Plummer, R. F. D. 6, Melville Rd., Springfield, contract for pipe line; Chicago Bridge and Iron Works, 37 West Van Buren St., Chicago, Ill., contract for tank on tower. Est. cost of work, $50,000.

N. Y., Brooklyn—N. De Stefano, 257 Glenn Ave., Tompkinsville, and L. Bignalo, awarded contract by Commr. N. J. Hayes, Municipal Bldg., N. Y. City, for mains in various thoroughfares, at $78,813.

N. Y., Long Island City—Commr. of Water Supply, Gas & Elec., N. J. Hayes, let following contracts for water mains: Paladino Contg. Co., 437 E. 120th St., N. Y. City, mains in Queens Blvd., at $116,729; Constantia, E. Willitson, 83rd, 8th and

various other streets, at $48,393 and $11,275, respectively, to J. A. Gregory, 351 E. 124th St., New York City.

Penn., Ashland—Pottsville Construction Co., Pottsville, awarded contract by Borough for constr. of impounding reservoir for domestic water supply, at $262,324.

Penn., Red Lion—Gannett, Seelye & Fleming, Engrs., Inc., No. Market St., Harrisburg, awarded contract by Red Lion Water Co. for conc. standpipe, 4 miles cast iron force mains, storage dam and reservoir; also pumping station and filter plant, at $250,000.

O., Painesville—Pitt Constr. Co., Diamond Bldg., Pittsburgh, Pa., awarded contract by City for 35x80-ft. pump rm., 35x35-ft. filter bldg.; three 20x24-ft. conc. basins; 12 ft. deep and gravity sand filters, etc. Engineer's est. $40,000.

S. C., Spartansburg—Burford, Hall & Smith Citizens & Southern Bank Bldg., Atlanta, Ga., awarded contract by City for machinery in water works pumping station on Pacolet River, at $70,000.

Tex., Lamesa—T. J. Whalen, Lubbock, awarded contract for water works and sewerage impvts., at $64,173.

Tex., Littlefield—Gantt-Baker, Inc., Okla. City, awarded contract by Comn., Littlefield, for water works sys., at abt. $64,000.

Wash., Seattle—J. L. Smith, awarded contract for reconstr. of Cedar River pipe line No. 2, at $91,194.

Wis., Madison—N. Quinn, 515 W. Johnson St., awarded contract by City for limestone sprinkling filters, at $197,000.

Wis., Madison—O'Dea & Shafer Co., 1019 Oregon, Madison, awarded contract for constr. of new reservoir, at $123,000.

Wis., Milwaukee—W. T. Werner, 675 Hi-Mount Blvd., awarded contract by Dept. of Public Works for 5,500 lin. ft. 54-in. cast iron mains in Burleigh St.—35th to 51st. Sts.—at $79,585; 13,019 ft. 6-in. mains to F. E. Kaminski, 745 46th Ave., West Allis, at $10,338; 7,644 ft. 8-in. and 1,935 ft. 12-in. mains in various streets, to Wenzel and Henoch Co., 498 27th St., at $4,443 and $9,043, respectively.

Prospective Work

ROADS AND STREETS

Ala., Montgomery—State Highway Comn., Montgomery, plans to expend $260,000 to repair, resurface and rebuild Decatur-Tuscumbia road.

Cal., Burbank—Streets to be widened to 100 ft. are as follows: Olive, Magnolia, Alameda, Buena Vista, Verdugo and Empire Aves., Lincoln St.

Cal., El Centro—Paul E. Kressly, H. W. Hellman Bldg., Los Angeles, appointed engineer and has been authorized to make surveys and prepare plans and estimates for paved highway betw. Calexico and State Hwy. at east high line canal; approx. 19 miles. Work is to be done under Rd. Impvt. Dist. plan and is designated as R. D. I. No. 6. Est. cost, abt. $300,000.

Cal., San Francisco—National forest highway sys. for this State, approved by Secy. of Agriculture. District Forester, Paul G. Redington. System comprises 65 roads totaling 2,045½ miles within national forests of State that are eligible to receive aid from forest hwy. funds appropriated by Congress. $2,527,632 authorized by Congress for expenditure on these roads in California. Following are projects approved: 32.8 mi. Bakersfield-Freeman Proj. Sequoia Natl. Forest; 15.5 mi. Cuyama Proj. Santa Barbara N. F.; 3.6 mi. Cuesta Pass Proj. Santa Barbara N. F.; 11.0 mi. San Marcos Proj. Santa Barbara N. F.; 20.0 mi. Ridge Rte. Proj. Santa Barbara N. F.; 16.0 mi. San Francisquito Proj. Santa Barbara N. F.; 16.0 mi. Boquet Proj. Santa Barbara N. F.; 25.0 mi. Arroyo Seco Proj. Angeles N. F.; 20.0 mi. West Fork-San Gabriel Proj. Angeles N. F.; 28.0 mi. San Gabriel Proj.; 28.0 mi. Swartout Proj., 15.2 mi. Cajon Proj., 45.0 mi. Bear Valley Proj., 9.8 mi. Fawnskin Proj.—all in Angeles Natl. Forest; 13.0 mi. City Creek Proj. Angeles N. F.; 25.0 mi. Mill Creek Proj. Angeles N. F.; 16.0 and 28.4 mi. Palomar and El Cajon-Jacumba Projects in Cleveland National Forest.

Cal., Long Beach—Street Supt. Ted Bruce has made necessary surveys for surfacing Long Beach Blvd., Atlantic and Cherry Aves., with disinteg. granite. Abt. $70,000 appropriated from City's municipal oil fund for this work.

Cal., Los Angeles—City Engineer instructed to prepare plans and specifications for opening 3rd St.—Alameda to Hewitt Sts.—and for widening of Hewitt St. east to Merrick St. Est. cost, $1,000,000.

Cal., San Diego—Petition in circulation in County for 4-mile road from paved highway betw. Oceanside and Bonsal thru Guajome Ranch and connecting with present dirt road west of Vista.

Fla., Bushnell—Sumter County, Center Hill District, plans 3 roads and bridges. $120,000 bonds voted.

Fla., Ft. Pierce—St. Lucie County plans 68 mi. paved, and 33 mi. graded, roads in Ft. Pierce-South County section thru back country connecting with hard surf. highways, with extensions from Ft. Pierce, White City, Walton and Jenson, connecting with Ft. Pierce-Okeechobee Rd. and proposed Ft. Pierce-Goslin Road. $845,000 bonds voted. E. H. Collins, Jr., County Engr.

Fla., Fort Pierce—City (W. Austin Smith, City Mgr.) will receive bids about middle of July for sheet asphalt on rock base, Florida limestone, penetration, concrete paving. Est. cost $1,000,000; sidewalks, $50,000. Plans on file.

Fla., Tallahassee—State Rd. Dept., Tallahassee, plans expending $60,000 for 2 roads; Rd. No. 10 betw. Leon Co. line and Blockers Ferry; dr. to Wakulla Beach.

Fla., Tampa—Hillsborough County (Tampa, County Seat) has prepared another road and bridge constr. program which will total in cost $3,355,000. Fourteen projects are included which have been approved by Co. Commissioners and legislative committee of Tampa Bd. of Trade, and bills covering the different projects are now pending in the Legislature which is expected to pass them before adjournment.

Idaho, Boise—State program for road impvts., approx. 150 miles paving and surfacing which will cost approx. $1,560,000; total of 18 bridges will be built, 3 steel, 12 conc. and 3 wooden. Combined cost, $450,000. Combined munic pal impvts. in Emmett, Coeur d'Alene, Nampa, Idaho Falls, Pocatello, Burley, Rupert and Lewiston will be as follows: Curb, $43,185; grading, $31,086; street paving, $14,444; storm sewers, $100,000; san. sewers, $72,000; park sys. impvts., $30,000; water system impvts., $12,000; one bridge, $12,000 and one at $3,000.

Ky., Falmouth—Pendleton County (Falmouth) plans to improve various roads. $150,000 bonds sold.

Ky., Frankfort—State Highway Commission plans 3 roads: From Dawson Springs to Nortonville; Central City to Versailles via Leitchfield, Elizabethtown, Bardstown and Lawrenceburg; Bowling Green to Ky.-Tenn. State line, near Geddes, via Franklin. E. N. Todd, State Hwy. Engr.

Ky., Louisville—City (Bd. of Public Works) will receive bids soon to rebuild 27 blocks of streets. Est. cost, $200,000.

Ky., Mayfield—Graves County Commrs. plan road bldg. Will vote in August on $400,000 bonds.

La., New Orleans—City and La. Hwy. Comn. (Reymond Bldg., Baton Rouge), have approved plans to pave Claiborne Ave.—Jefferson Parish line to La. Ave. Est. cost, $500,000.

Miss., Jackson—State Highway Dept., Jackson, plans to grade and bridge 2 roads: Winston Co., 20 miles from Louisville to Philadelphia, at est. cost $200,000; Hinds Co., 4.610 mi. Jackson-Tougaloo rd., at approximately $48,000.

Miss., Starkville—Oktibbeha County plans road bldg. Considering $450,000 bond issue.

Mo., Clinton—City will receive bids in July or first Tuesday in August to pave with conc. one-half mile Main St., 3 blks. N. Main; 5 blks. E. Green and 4 blks. E. Grand River St., H. C. Allen and E. T. Archer & Co., Cons. Engrs., New England Bldg., Kansas City.

BUYERS' GUIDE

Aerial Tramways.
American Steel & Wire Co.

Air Lift Pumps.
Harris Air Pump Co.

Armor Plates.
Truscon Steel Co.

Asphalt.
Bitoslag Paving Co.
The Barrett Co.
Kentucky Rock Asphalt Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Asphalt Paving Co., The

Asphalt Filler.
The Barrett Co.
Bitoslag Paving Co.
Standard Oil Co. (Indiana)
The Texas Co.
Warren Bros. Co.

Asphalt Floors.
The Barrett Co.
The Texas Co.
Warren Bros. Co.

Asphalt Machinery.
Chausse Oil Burner Co.
Cummer & Son Co., The F. D.

Asphalt Plants.
Austin Machinery Corporation.
Cummer & Son Co., The F. D.
Littleford Brothers.
Warren Bros. Co.

Asphalt Railroad Plants
Cummer & Son Co., The F. D.
Warren Bros. Co.

Asphalt Tools.
Chausse Oil Burner Co.
Littleford Brothers.
Warren Bros. Co.

Asphalt Tool Wagons.
Chausse Oil Burner Co.
Littleford Brothers.

Auto Fire Apparatus.
Kissel Motor Car Co.
International Motor Co.
Pierce-Arrow Motor Car Co.

Automobiles.
Ford Motor Co.

Back Fillers.
Austin Machinery Corporation.
Pawling & Harnischfeger.

Bar Cutters and Benders.
Koehring Co.

Bars, Reinforcing.
Truscon Steel Co.

Binders, Road.
The Barrett Co.
Pioneer Asphalt Co.
Standard Oil Co. (Indiana)
The Texas Co.
Uvalde Asphalt Paving Co.
Warren Bros. Co.

Bituithic Pavements.
Warren Bros. Co.

Blasting Accessories.
E. I. du Pont de Nemours & Co., Inc.

Blasting Powder.
E. I. du Pont de Nemours & Co., Inc.

Bodies.
Lee Trailer and Body Co.
Littleford Brothers.

Braces, Extension.
Kalamazoo Fdy. & Machine Co.

Brick Rattlers.
Olsen & Co., Tinius.

Brick-Testing Machinery.
Tinius Olsen Testing Mach. Co.

Brick, Paving.
National Paving Brick Mfrs. Assn.

Bridges.
Luten, Daniel B.

Buckets, Dredging, Excavating and Sewer.
Pawling & Harnischfeger.

Buckets, Dumping
Littleford Brothers.
Pawling & Harnischfeger

Cableway Accessories.
Sauerman Bros.

Cableway Excavators.
Sauerman Bros.

Calculators.
Kolesch & Co.

Car Unloaders.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.

Castings.
U. S. Cast Iron Pipe & Fdy. Co.

Cast Iron Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Catchbasins.
Dee Co., Wm. E.
Madison Foundry Co.

Cement Gun Work.
Indiana Gunite & Const. Co.

Cement Testing.
Chicago Paving Laboratory.
Flood & Co., Walter H.
Howard, J. W.
Hunt Co., Robert W.
Indianapolis Paving Laboratory.
Van Trump, Isaac.

Cement Testing Machinery.
Tinius Olsen Testing Mach. Co.

Central Heating Plants.
American District Steam Co.

Chemists, Engineering
Chicago Paving Laboratory.
Dow & Smith.
Flood & Co., Walter H.
Howard, J. W.
Hunt Co., Robert W.
Indianapolis Paving Laboratory.
Van Trump, Isaac.

Chimneys, Concrete.
Truscon Steel Co.

Chimneys, Steel.
Littleford Brothers.

Chloride of Lime.
Pennsylvania Salt Mfg. Co.

Clay Pipe, Vitrified.
Clay Products Assn.

Clay Products.
Clay Products Assn.

Concrete Bridges.
Luten, Daniel B.

Concrete Mixers.
Austin Machinery Corporation.
Koehring Co.
Smith Co., T. L., The

Concrete, Reinforcement.
American Steel & Wire Co.
Truscon Steel Co.

Conduits.
Cannelton Sewer Pipe Co.
Carey Co., Philip, The.
Rosing, Inc., Astrid S.
Truscon Steel Co.

Conduit Rods.
Stewart, W. H.

Consulting Engineers.
Alvord, Burdick & Howson.
Artingstall, Wm.
Brossman, Chas.
Burd & Giffels.
Chicago Paving Laboratory.
City Wastes Disposal Co.
Dow & Smith.
Druar & Milinowski.
Flood, Walter H., & Co.
Howard, J. W.
Hunt Co., Robert W.
Indianapolis Paving Laboratory.
Jones, Sam L.
Kirchoffer, W. G.
Kirschbraun, Lester.
Luten, Daniel B.
Potter, Alexander.
Van Trump, Isaac.
Wells, James P.

Contractors.
City Wastes Disposal Co.
Sullivan, Long & Hagerty.
Warren Bros. Co.

Contractors' Tools and Machinery.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.
Smith Co., T. L., The

Contractors' Wagons.
Austin Machinery Corporation.
Austin-Western Road Machinery Co.

Conveying Machinery.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.
Portable Machinery Co., Inc.
Webster Mfg. Co.

Cranes and Hoists.
Austin Machinery Corporation.
Heltzel Steel Form & Iron Co.
Pawling & Harnischfeger.

Creosote.
The Barrett Co.
Republic Creosoting Co.

Creosoted Wood Block.
(Factory Floors, Bridge Floors)
Republic Creosoting Co.

Crushers, Rock and Ore.
Austin-Western Road Machinery Co.
Good Roads Machinery Co., Inc.

Culvert Pipe, Vitrified.
Cannelton Pipe Co.
Dee Clay Mfg. Co., Wm. E.

Culverts.
Austin-Western Road Machinery Co.
Newport Culvert Co.
Truscon Steel Co.

Curb and Gutter Forms.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Curb Bar.
Truscon Steel Co.

Mo., Sedalia—City plans to grade and pave 13 streets, including 5 with concrete.

Nev., Carson City—Plans have been completed on following projs.: 10 miles grav. surf. 90-D, Wells to Moor, Elko Co.; 15.5 mi. grav. surf. Dutch John's to no. county line, Lincoln Co.; 7 mi. grav. surf. Wadsworth to .75 miles east, Washoe Co.; 4.60 mi. 9½ miles east of Yerington to Co. line, Lyon Co. (80-B); 7 miles Connors Pass to South Co. line, White Pine Co.; steel truss at Wadsworth; 5:63 mi. Douglas Co. (gravel surf.), 5 miles e. of Holbrook to east Douglas Co. line. Plans are being prepared on following: 16 mi. grading, Hafed to Derby; 4.00 mi. Elko Co. grav. surf. 90-C, R. R. grade separation near Silver Zone; 11 mi. Mineral Co. grav. surf. No. Co. line to Schurz; 2.5 mi. grading Sparks to Vista, Washoe Co.; 5.5 miles Co. line to Virginia City (Geiger grade), Storey County.

N. Car., Rockingham—Richmond County Commrs. plan hard surfacing 2 roads; 11 miles Rte. 50 from Rockingham to So. Caroline line; 10 miles Rte. 51 from Ellerbe to Rockingham. Considering $300,000 bond issue.

Okla., Perry—Noble County plans road bldg.: $900,000 bonds voted.

S. C., Clinton—$160,000 bonds voted for street paving. J. F. Jacobs, Mayor.

S. C., Columbia—City plans 87 blocks of street paving; contemplates $500,000 bond election. W. A. Coleman, Mayor.

S. C., Laurens—Laurens Co. Hwy. Commission plans to build 4 or 5 roads, including top soil rd. from Laurens to Brands thru Pearidge section to Jones Ford Brdg., connecting with rd. from Clinton to Lanford Sta. and from Cross Hill to Clinton-Belfast rd. $250,000 available.

Tex., Belleville—Austin County plans grading and constr. of bridges on 16.89 miles State Hwy. No. 36. Est. cost, $115,000. I. Hill, Judge. Herbert Schroeter, Engr.

Tex., Ft. Worth—Tarrant County plans rebldg. Ft. Worth-Dallas Pike. Est. cost, $500,000.

Tex., Gonzales—State Hwy. Dept., Austin, has approved plans to grade and bridge 10.88 miles State Hwy. 81. Est. cost, $78,000. J. G. Irby, Co. Engr. J. C. Romberg. Co. Judge.

Tex., Harlingen—$172,000 bonds voted here for street paving and impvts.

Tex., Port Texas—City will soon receive bids for 90,000 yds. asphaltic, rock asphalt, or brick paving. Est. cost, $290,000. J. P. Logan, Mayor. J. O. Herpin, City Engr. Nagle, Witt & Rollins, Engrs., Keystone Bldg., Houston.

Tex., Sherman—Grayson County Commrs. plan to improve highways. Contemplate $5,000,000 bond election.

Utah, Ogden—Forest Service allotted $170,000 to be expended on road and trail constr. in Idaho south of Salmon River. According to program abt. 70 miles of road and 200 miles of trail will be built.

Wash., Bellingham—Municipal impvts. at Bellingham will include $15,700 for curbing, $30,600 on grading, $85,400 on street paving; $14,500 on alley paving; $3,750 on storm sewers and $5,000 on sanitary sewers. Impvts. in park system, $25,000.

Wash., Olympia—Highway constr. plans for 1925 in State will include 50 miles fed. aid pave. and surf. projects, totaling $1,132,000. There will also be under constr. 225 miles state rd. surf., $2,137,000. Bridge constr. will include 8 steel bridges costing approx. $1,900,000; 20 conc. brdgs. to be built at est. cost $946,000 and 4 wooden brdgs., $30,000.

Wash., Seattle—City will construct approx. 350,000 ft. curb, 215,000 lin. ft. street pavement; 14,000 lin. ft. alley pavement. Est. cost about $2,000,000; 135,000 ft. grading, including conc. walks at an approx. cost of $1,250,000; 200,000 ft. storm and san. sewers costing abt. $1,200,000; 2,225,000 ft. water mains and pipe lines est. to cost $2,000,000; also bridges and trestles to amt. of approx. $800,000. Total cost of these various improvements, $7,250,000.

Wash., Spokane—Estimated municipal impvts. in Spokane include 90,000 ft. curb at approx. $45,000; 28,000 ft. grading to cost abt. $50,000; 9,000 ft. street paving, $70,000; 15,000 ft. san. sewers, $90,000; wells, pumps, reservoirs, water mains and taps, $415,000; repairs on bridges, $10,000.

Wash., Tacoma—Following are impvts. contemplated in Tacoma for 1925: 26,400 ft. curb, $12,000; 10,560 ft. grading, $20,000; 31,680 ft. street pavement, $240,000; 10,560 ft. alley paving, $50,000; 5,260 ft. storm sewers, $60,000. Total cost, $862,000.

W. Va., Glenville—Gilmer County, De Kalb District, plans road impvt. around Grantville and Tanner sections. $207,000 bonds voted. Troy District, Gilmer County, plans impvt. of roads including Parkersburg-Staunton turnpike. Contemplate $180,000 bond issue.

SEWERAGE AND SEWAGE TREATMENT

Ala., Montgomery—City will construct southern outfall sewer at cost of $125,000.

Ala., Selma—City considering expenditure of $160,000 for sewer extensions.

Cal., Santa Barbara—City Engineer (Geo. D. Morrison), preparing plans for lower east side sewer system, comprising approx. 3 miles sewer lines.

Cal., Watsonville—$186,000 sewer bond issue carried at recent election. Of this amount, $146,000 will be expended for pipe line to Monterey Bay 5 miles west, which is to extend 1,400 ft. into the water; also $40,000 for sewerage system and extension of sewerage system into annexed Watsonville Hts. Dist.

Fla., Arcadia—$310,000 bonds voted here for sewers and water works; $10,000 for white way.

Fla., Fort Lauderdale—City considering voting on $500,000 bonds for sewer, disposal plant and incinerator.

Fla., Kissimmee—City plans expending $1,100,000 for 12 mi. paving, constr. of sewers and water extens., also municipal bldgs. For detailed information, address City Clk.

Fla., St. Petersburg—City having plans prepared for sewage disp. plant and sanitary sewer extensions; install sewage pumping equipment. Ernest Kitchen, Director of Public Works.

Ga., Dalton—$20,000 bonds voted here for sewer extensions.

Ill., La Grange Park—(La Grange, P. O.)—Town making preliminary plans for 271 ft. 24-48 inch sewers under railroad right-of-way; also 69,541 ft. 10 to 72-inch sewers, etc., in Special Assessment Dist. 28. Est. cost, $488,622.

Iowa, Waterloo—Making plans for construction of sewage disp. plant to include installation of 4 Imhoff septic tanks with sprinkling filters, lift station with elec. driven centrif. pumps, trickling filter; abt. 361x361x9, 4 sludge beds, 126x18, 4 dosing chambers, grit chamber, with screens, and res. for caretaker. Engineer's est., $800,000. City Engr., Ralph B. Slippy. City Clk., Chas. C. MacKay.

Md., Hagerstown—City (Charles E. Bowman, Mayor, will issue $75,000 bonds for completing sewage treatment plant.

Mass., Boston—Mayor has approved request of Public Works Department for following constr. work: Surf. drain 10-in., 12-in., 15-in., 18-in., 20-in. and 24-in. earthern pipe, 30 catch basins and one drop inlet in Western Ave. (no. side). Est. cost, $32,000; san. sewer, 1-ft. 10-in. by 1-ft. 3-in. conc. surf. drain of 2-ft. by 4-ft., 4-in. 1-ft. 10-in. by 3-ft. 4-in., 18-in. by 20-in. conc. and 15-in. pipe surf. drain, 200 ft. minor drain and 7 catchbasins in Kilmarnock St. Est. cost, $29,849; san. sewer 10-in. 12-in. 15, 18, 20 and 24-in. earthern pipe, surf. drain 12-in. 15, 18 and 24-in. earthern pipe, and 3-ft. by 3-ft. 4-ft. 6-in. by 4-ft. 6-in., 5-ft. by 5-ft., 6-ft. by 6-ft. concrete, 450 ft. minor drain and 4 catch basins in Dorchester brook, private land. Est. cost, $96,684; surf. drain, 10-in. earthen pipe and 6 catchbasins in Presentation Rd. Est. cost, $4,900; sanitary sewer 10-in. earthen pipe in River St. S. E. side betw. Monponset St. and Alpine St. River St.—65 ft. west of Massasoit St. to Wachusett Sts. and in Monponset St.—River St. 35 ft. s. east, Hyde Park Dist. Est. cost, $2,960; surf. drain 10-in. and 12-in. earthen pipe, 3 catch basins and 150 ft. minor drain in Verril St. Est. cost, $3,000.

BUYERS' GUIDE

Deep Well Pumps.
Harris Air Pump Co.
Keystone Driller Co.

Drag-Line Excavators.
Austin Machinery Corporation.

Drag Scrapers.
Austin-Western Road Machinery Co.

Drain Tile.
Dee Clay Mfg. Co., W. E.
Rosing, Inc., Astrid S.

Dryers.
Cummer & Son, The F. D.

Dump Cars.
Austin-Western Road Machinery Co.

Dump Wagons.
Austin-Western Road Machinery Co.

Dust Laying Compound.
The Barrett Co.
Standard Oil Co. (Indiana)
The Texas Co.

Dynamite.
E. I. du Pont de Nemours & Co., Inc.

Edge Protector.
Truscon Steel Co.

Electrical Machinery.
Westinghouse Electric & Mfg. Co.

Electrical Wires & Cables.
American Steel & Wire Co.

Elevating Graders.
Austin-Western Road Machinery Co.

Excavating Machinery.
Austin Machinery Corp.
Pawling & Harnischfeger.
Sauerman Bros.
Smith Co., T. L., The

Expansion Joint Compound.
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
Truscon Steel Co.

Explosives.
E. I. du Pont de Nemours & Co., Inc.

Fillers (Paving Joint).
The Barrett Co.
Carey Co., Philip, The
Pioneer Asphalt Co.
The Texas Co.

Fire Brick.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Flue Liners.
Cannelton Sewer Pipe Co.
Dee Clay Mfg. Co., W. E.

Forms, Sidewalks, Curb & Gutter.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Forms, Road.
Heltzel Steel Form & Iron Co.
Truscon Steel Co.

Gas Pipe.
U. S. Cast Iron Pipe & Fdy. Co.

Gates, Sluice.
Coldwell-Wilcox Co.

Graders.
Austin-Western Road Machinery Co.

Granite Block.
Granite Paving Block Mfrs. Assn. of the U. S., Inc.

Gunite.
Indiana Gunite & Const. Co.

Heaters (Rock and Sand).
Littleford Bros.

Heating Plants, Central.
American District Steam Co.

Heating Wagons (Oil and Tar).
Good Roads Machinery Co., Inc.
Littleford Bros.

Hoists (Concrete, Gasoline and Hand).
Pawling & Harnischfeger.

Hoists, Electric.
Mead-Morrison Mfg. Co.
Pawling & Harnischfeger.

Hoists, Steam.
C. H. & E. Mfg. Co.
Mead-Morrison Mfg. Co.

Hot Mixers.
Austin Machinery Corp.

Inlets (Sewer).
Dee Co., Wm. E.
Madison Foundry Co.

Insulating Material.
The Barrett Co.
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Okla., Blackwell—City will construct 15,000 ft. 8-in. v.c. sewer, 3,000 ft. v.c. sewer; install 18,000 ft. 8 and 10-in. v.c. pipe; 15 ft. lift; 8-in. pumps; 2 sewer pumps; 8-in. and 2 motors. Wm. R. Haupt, Jr., City Engr.

Okla., Mangum—City reported considering installing $75,000 storm sewer. Engrs., Benham Engineering Co., 512 Gumble Bldg., Kansas City, Mo.

Okla., Okla. City—Election in July to vote on $825,000 bonds for erection of 2 plants; one on no. and one on south side; consist of Imhoff tank and sprinkler system complete. Warren E. Moore, Commr. Public Works.

Tex., Palmer—City will vote on $20,000 sewer bonds. E. L. Dalton, 319 Wilson Bldg., Dallas, Cons. Engr.

Wash., Seattle—City Council (Streets & Sewers Committee) has recommended installation of trunk sewer on Michigan St. Project involves expendt. of $411,892.

WATER SUPPLY AND PURIFICATION

Ariz., Mesa—Weiland Engrg. Co., 725 Thatcher Bldg., Pueblo, Colorado, has prepared plans for impvts. to water system under $80,000 bonds recently voted. Impvts. will include 3,060 ft. 12-in. 790 ft. 10-in., 7,870 ft. 8-in., 11,820 ft. 6-in., 1,540 ft. 6-in. and 11,500 ft. 4-in. cast iron pipe, 10 tons cast iron specials, 15 6-in. fire hydrants, 10 8-in. valves, 5 6-in. valves, 50 4-in. valves, 20 4-in. valves, one 20-in. diam. well, pump sump, elec. equipt., pumping equipt. (2 pumps of 1,000 gals. per min. each).

Cal., Orange—City plans election on $1,200,000 bonds for water plant, including 47,000,000 gal. reservoir, wells, pumping plant, distribution system, etc.

Ont., Hamilton—Addition planned to pumping station. $250,000. W. McFaul, City Engr.

B. C., New Westminster—City plans 14 miles 14-in. steel mains from Coquitlam Lake to City, in order to reorganize water system. $750,000.

Fla., Arcadia—$310,000 bonds voted here for sewers and water works, $10,000 for white way.

Fla., Tampa—City will construct $228,000 water works plant west of Hillsborough River, at $228,000.

Ky., Paducah—Paducah Water Company has acquired water works franchise; will expend about $400,000 for impvts.

Md., Baltimore—Public Improvement Commission planning construction of 2 water mains to Brooklyn and Curtis Bay. Est. cost, $500,000.

N. Car., Asheville—City contemplates erection of pipe line from water shed to City at cost of $350,000. Frank L. Conder, Commr. of Public Works.

Ohio, Youngstown—City considering new water works to be developed from source other than Mahoning River. Est. cost $5,000,000. Engr. not selected.

Okla., Okmulgee—City making plans for new water supply on Salt Creek, including reservoir, pipe line, new pumping equipment, etc. Approx. cost, $1,000,000. Holway Engrg. Co., Wright Bldg., Tulsa, Cons. Engrs.

Tenn., Clinton—Town will install water works plant. Bids for machinery and construction will be opened in August. Will install machinery to cost $110,000. Campbell Wallace, Empire Bldg., Knoxville, Engr. Glen C. Medaris, Mayor.

Tex., San Antonio—City has plans by Allen Hazen, Water Engr., 25 West 43rd St., New York City, for $130,000 reservoir in northwestern section of City; 100x60 ft.; interior constr. of steel and exterior construction, concrete; capy. 1,000,000 gals.

Tex., Waco—Chamber of Commerce reported interested in plans for damming Bosque River and laying gravity line from Lake Bosque to filter plant; forming lake covering 8 sq. miles, impounding 30,225,000,000 gals. water.

Va., Norfolk—City (W. B. Causey, Mgr.) contemplates expending $70,500 for impvts. to service in So. Norfolk.

Wash., Centralia—City Commission has directed City Engr., in conjunction with Water Supt., to prepare immediately plans and specfs. for 3 reservoir propositions, bids to be asked on all 3 projects and lowest and best bid to be accepted for construction of one of them. Two plans provide for reservoirs of 5,000,000 gals. capy., and one for 10,000,000 gals.

Wash., Port Angeles—Northwestern Power & Elec. Co., Port Angeles, has been granted permission to appropriate 600 second ft. of water from Elwha River, by R. K. Tiffany, State Supvr. of Hydraulics. Permit to store 15,000 acre ft. of water in Glines canyon reservoir also issued. Company will construct $800,000 hydro-elec. proj. Water will be used at a 150-ft. head and plant will generate approx. 10,227 h.p. of elec. energy. Impounding dam will be 60 ft. high, 490 ft. wide on top and 60-ft. wide on bottom. Reservoir will have area of 400 acres which will be flooded to av. depth of 65 ft.

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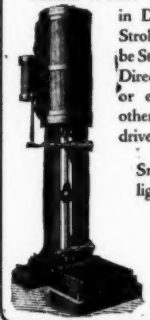

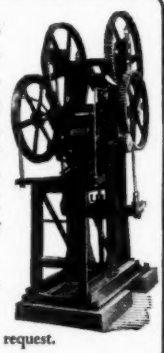

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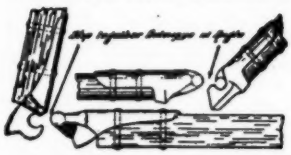

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THE GLASS COVERED SLUDGE DRYING BED

By Waldo S. Coulter, Consulting Engineer, 11¼ Liberty St., New York.

The glass covered sludge drying bed originated at the Cleveland experiment station in 1913. This original cover was a small A-roofed structure with gable ends and roof of glass. Experiments indicated that the protection from rain and frost, and the increased temperatures under the cover, resulted in increased efficiency per unit of bed area, about one-half square foot per capita being required for sludge from two-story tanks.

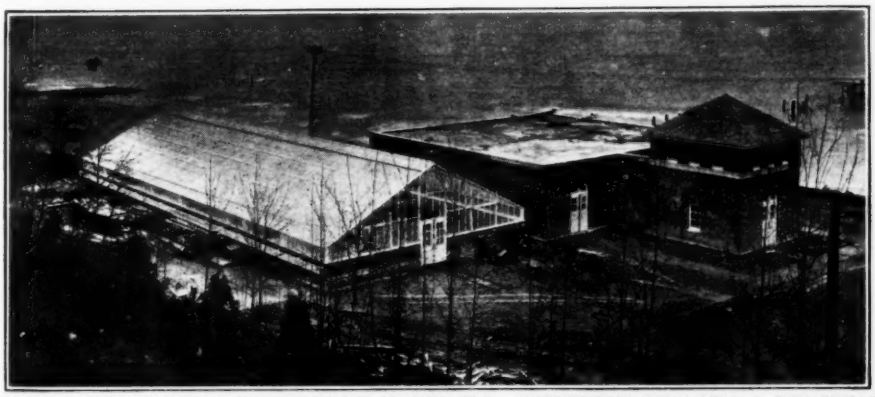
In his "Elements of Geology," Le Conte observes: "Many bodies which are transparent to light are opaque to heat. Such bodies, however, will freely transmit heat if the heat be accompanied with intense light. It is as if the light carried the heat through with it. Heat thus associated with light is sometimes called *light-heat*, while that which is not thus associated is called *dark-heat*. Now, the bodies spoken of are *transparent* to light-heat, but *opaque* to dark-heat. Glass is such a body. If a pane of glass be held between the face and the *sun*, the heat passes freely and burns the face, but the same pane would act as a *partial* screen before a *fire*, and as a *perfect* screen before a hot, but not incandescent, *cannon-ball*. It is in this way we explain the fact that a glass greenhouse, even in the coldest sunshiny winter's day, becomes insupportably warm if shut up. The sunlight and heat pass freely through the glass, and heat the ground, the benches, the flower-pots, but the light-heat thereby becomes converted to dark-heat, and thus is *imprisoned* within."

The italics are Le Conte's.

A foot note on the same page states: "On Mount Whitney, in the sunshine, Langley got, in a box covered with glass, a temperature of 236 degrees F, or 113.3 C, while in the shade of the open air the temperature was only 58.6 degrees F or 14.8 degrees C."

Operative glass covered drying beds have been installed here and there since 1913 but, until recently, they received no general recognition. The writer designed an operative glass covered bed in two units, with a penthouse roof, resembling an enlarged hotbed, in 1915. The total area was about 600 sq. ft. He has since constructed numerous others of the same general design, up to 1,600 sq. ft. From his experience with these beds, it appears that for Imhoff sludge, about 0.5 to 0.6 sq. ft. of net area per capita is required; that in summer the temperature in the enclosure may reach 150 F, with the vents closed, with temperatures of 70 or so on a sunny winter's day; that on winter nights the temperature falls rapidly during the early morning, but rarely reaches the freezing point; that the air in the enclosure becomes saturated with moisture on warm days, in the presence of wet sludge, unless the enclosure is adequately ventilated, resulting in excessive condensation on the glass and walls; that no effective evaporation from the sludge can take place unless the air in the enclosure is constantly removed and replaced; that fresh sludge admitted to a compartment already containing partly dried sludge will retard the drying of the latter; that air removed from the enclosure should be discharged well above the ground surface, if an odorous sludge is being treated, to avoid noxious odors.

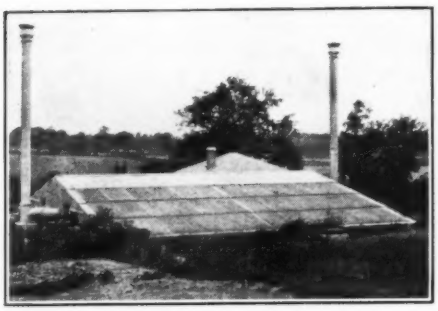
Acting on this experience, he divides



GREENHOUSE TYPE AT HIGHLAND PARK, ILL., COURTESY OF LORD & BURNHAM CO., NEW YORK.

the enclosure into separate units by tight walls extending to the roof, each unit being separately vented, and provides induced circulation of air by screened, adjustable vent inlets and vent stacks 30 to 50 ft. high, topped by siphon-type ventilators. It is, of course, evident that without adequate ventilation, condensed water vapor will be returned to the sludge, the interior of the enclosure becoming at times a dripping steam box, very ineffective as a drying device.

The hotbed type of construction, which the writer has used, consists in general of a concrete surrounding wall and concrete partition walls extending to the cover, with a framework, usually of timber on supporting posts of concrete, upon which hotbed sash are placed. Single-



EXTERIOR OF HOTBED TYPE AT SPRING VALLEY, N. Y. DESIGNED BY WALDO S. COULTER.

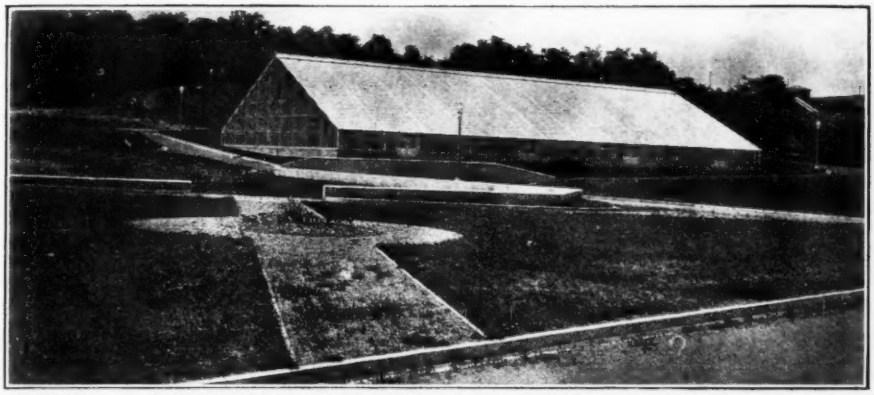
glazed sash will suffice and may be easily handled by one man. It is best to avoid the rather flimsy, light weight hotbed sash frequently sold by local dealers, and secure those manufactured by makers specializing in hotbed and greenhouse supplies. The glass should be protected at small plants by a heavy wire fabric of about ½-in. mesh, each individual sash being separately covered by wire fastened to the frame with staples. This is necessary to prevent breakage of glass by small boys. Incidentally, it affords worthwhile protection against heavy hail. Wire glass has been suggested, but such glass is very heavy, costly and increases the cost of the supporting framework. The hotbed roof has a pitch of 3 ins. to a foot, more or less, and the clearance beneath may be about 4 ft. at the lower end to 7 or 8 ft. at the upper. With its flat pitch, the cover is of course designed for a maximum snow load. The sash are laid to lap at the ends, the bottom rail of the one above overlapping the top rail of the next lower by the width of the rail. To hold sash in place, while rendering them readily removable, stud bolts in the supporting beams project, with a loose fit, through holes in the lapped rails. Simplicity requires that the sides of the sash shall butt. The roof is not therefore weathertight, and some rain water enters during storms, though not enough to affect the action of the bed. The butting of sash also permits the circulation of some air through the cracks, so that the temperatures obtained in such beds cannot be fairly compared with those to be secured in a tightly closed florist's greenhouse. On the other hand, the headroom is relatively low, and the air content of the enclosure is much less per foot of bed area than in a florist's greenhouse, which makes for higher temperatures.

The principal advantage of the hotbed type is its relative inexpensiveness and the fact that any general contractor can build one. The glazed cover and supporting framework costs, including contractor's profit, about 40 to 45 cts. a square foot. This does not include the concrete surrounding walls.

Removal of the dried sludge from covered beds of the hotbed type may be effected through runways, through large doors in the surrounding wall at the high side (which may communicate with an industrial railway track), or by lifting off a few sash at the low end and shoveling it out. For small plants the latter arrangement will be found satisfactory.

During the past two years, several unusually large covered beds have been constructed and others are projected. The covers for these beds are patterned after the florist's greenhouse and may be called the greenhouse type. The foundation walls to 2 to 4 ft. above the ground are of brick and concrete masonry. On these is constructed the greenhouse, with vertical side walls 3 ft. or so in height, an A-roof and gable ends, all of glass with a framework of steel. The clearance beneath the ridge may be 15 ft. or more, the whole constituting a roomy, glass-covered building.

No information is as yet available to the profession regarding operating results from large greenhouse type covers. To date, they have been built with low partition walls separating the sludge filter into bed units, but without any transverse partitions extending to the roof. That is, fresh sludge and partly dried sludge are contained in the same undi-



EXTERIOR OF GREENHOUSE TYPE BED AT BOONTON, N. J., ROCKAWAY VALLEY TRUNK SEWER, BY PERMISSION OF CLYDE POTTS, C. E., ENGINEER.

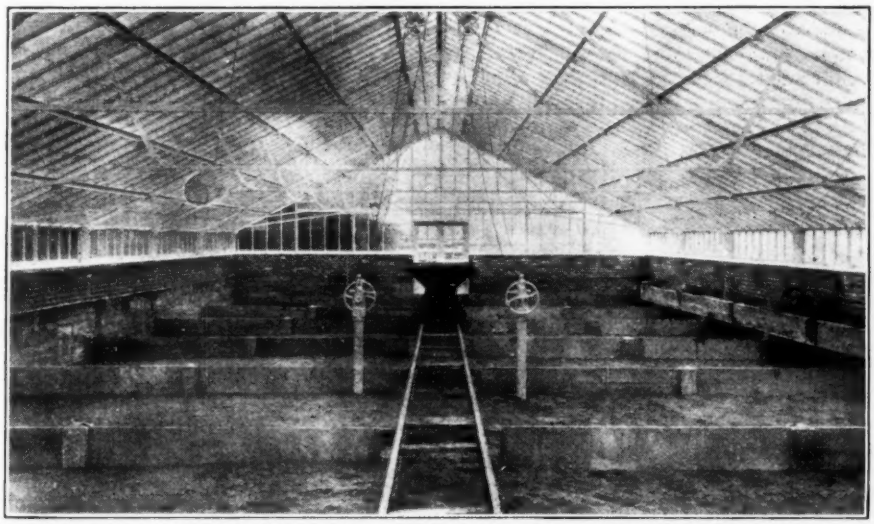
vided structure, separated by low bed walls. Ventilation is secured by tilting windows in the low vertical side walls and hinged sections near the apex of the roof, in the manner adopted for florists' greenhouses. These are manipulated from operating stands near the middle of the building. This arrangement affords very positive and efficient ventilation, but what the result will be outside, if the sludge is odorous and being newly applied, remains to be ascertained. Whether the necessity will develop for transverse partitions, to separate the building into a series of separate compartments, is uncertain.

For the removal of sludge, an industrial track extends lengthwise through the building, supported by the low bed walls, carrying a small dump car. Any necessity for transverse partitions would probably require a modification of the building design, with a track extending into each compartment from the side.

The results secured from relatively small units of the hotbed type cannot be fairly held to govern the design of large greenhouse units, and only operating results from large greenhouse beds can determine what, if any, changes may be required in future installations.

The protection of the glass at large plants may not be found necessary; experience will tell. Florists' greenhouses seem to require no such protection.

The construction of a greenhouse, such as that above described, must necessarily be undertaken by a builder special-



INTERIOR OF GREENHOUSE TYPE AT BOONTON, N. J. BY PERMISSION OF CLYDE POTTS, ENGINEER.

izing in such work. The cost of the glazed superstructure, exclusive of masonry, is about $1.50 a sq. ft. For small plants the unit cost would be larger.

Whether adequate ventilation of the large space between bed and roof will require the admission of so much air as to seriously affect winter temperatures in the enclosure, is another point which only operation can determine. Personally, the writer believes that the greenhouse drying bed is a step forward.

SOLVING THE CITY TERMINAL PROBLEM

By T. C. Powell, Vice President, Erie Railroad.

(Editor's Note:—The following address by Mr. Powell was delivered at the Midwest Motor Transport Conference held in Chicago in May of this year).

There is no more appropriate place to discuss the problem of distribution within the limits of a city, than before the National Automobile Chamber of Commerce because if there is one thing more than another that is responsible for street congestion, it is the automobile.

It is a difficult if not impossible task to state any new facts regarding street congestion because I contend that somewhere, and at some time, practically every fact has been developed and a solution has been suggested and sometimes put into operation.

In speaking to you, therefore, today on the question of solving the city terminal problem, I am reminded of the priest who was directed by his bishop to conduct a service in honor of a certain saint. Accordingly he gathered his congregation together and said to them:

"We celebrated last year the anniversary of the death of this blessed saint, and I undertook at that time to tell you everything I knew, or could find out, about him, and I think I ought to tell you *now* that although he has been dead over a thousand years I have not in the last year been able to collect any new information about him."

For this reason I shall not claim any originality in stating facts and conclusions but shall appropriate the thoughts and plans of others in so far as I think they are valuable. I think we should take pattern after the coral insect, which is apparently willing to continue to build up on the foundations laid by its predecessors.

I once heard Mr. George Westinghouse say that practically no invention could be commercially utilized in the form in which it came from the original inventor. In other words, its commercial value required study by more than one person and it was through cumulative study and experience that inventions became valuable.

We are sometimes deterred from solving a problem because of its apparent complications, but I think it would be well to start with the promise that "transportation is merely moving goods and people from one point to another," and that congestion in this process is merely the result of interruption.

Transportation Not Complicated

Dr. Daniels, Professor of Transportation at Yale University, recently said that the science of transportation is "a big practical method for moving things."

A recent English visitor to the United States,—Mr. Patterson, of Carter, Patterson & Company, said:

"A carrier conducts a primitive trade, and his art is to do simple things exactly, punctually, regularly and safely."

So you will see we cannot seek refuge behind the idea that transportation and congestion are problems too complicated to be solved. As I said, congestion is the result of interruption, and the solution of the city terminal problem and the prevention of congestion everywhere, depend simply and entirely upon the prevention of interrupted movement.

The definition of "dirt" is "matter out of place," and by the same token anything which interrupts or obstructs the free movement of vehicles or pedestrians, is dirt, because it is matter out of place. This may seem a harsh term to apply to some of the obstructions commonly seen on our streets and sidewalks, but it is only by a recognition of this condition that we can approach a solution of the city terminal problem.

Everyone is familiar with the axiom, that "you cannot put a quart of water into a pint vessel." You may be able to crowd into a room a large number of people, far beyond the comfortable capacity of the room; but if you start these same people to moving to some other locality you cannot compress them beyond a reasonable limit.

If you construct a passage way twelve feet wide and then obstruct it with pillars, posts or beams, or other immovable objects which project twelve inches into the

passage way, you have not, as a matter of fact, provided a channel twelve feet wide, but you have provided a passage only eleven feet wide, because a moving mass of people will not expand and contract but having once contracted to the minimum amount of continuous free space, the entire procession will continue in that way. You can prove this statement at any time by watching railway stations and platforms and other places where people congregate and move around in large numbers. Neither a human being nor a vehicle in motion can be compressed, any more than water can be compressed.

It is because this fact is overlooked that the general public is today subjected to inconvenience, discomfort and unnecessary expense in moving along the highways and through the streets of our cities and larger towns. This neglect of this well known fact is in my opinion the underlying cause of terminal and street congestion.

Causes of Traffic Interruption

I therefore think it worth while devoting a few moments to considering the causes of interruption and the reasons why the streets and passageways are obstructed.

I think a general answer is to say that a large portion of the trouble results from the selfish and inconsiderate attitude of the individual who undertakes to appropriate to his own use portions of the sidewalk or street which should be devoted exclusively to public use.

I saw a striking instance of this disregard for the public a few days ago in New York City. You are familiar with the Grand Concourse which has been constructed and which has provided a great highway for vehicular traffic. The volume of this traffic is so great that it has been found desirable to construct under-passes, and at a certain section of the concourse this construction work is now going on, with the result that the highway at that particular point is much restricted.

It so happens that on one side there is a row of retail automobile agencies, and one would suppose in the interest of their own business these parties would adopt every means to keep as free and uninterrupted as possible, the temporarily limited portion of the Grand Concourse; but from personal observation I can say, that in the short space of one block there were standing a few Sundays ago no less than five automobiles without drivers or occupants, so obstructing the street that where the authorities had left space for two lines of automobiles, these parked automobiles reduced the channel to a width sufficient for only one machine. To put it in another way: had these men given sufficient thought to their public duty they could immediately have doubled the capacity of the roadway by removing their idle automobiles to a side street or inside their show rooms.

Repair Havens Needed

Another cause of interruption is failure on the part of the authorities to realize that among the many thousand vehicles traversing the main highways some will occasionally be compelled to draw up at the side of the road to effect some temporary repair, such as an inner tube, and through this oversight there has been no space allowed, so that an automobile which finds it absolutely necessary to draw up at the side remains an obstruction which produces a greater or less effect upon the other traffic.

When canals were generally in operation it was customary to provide a space into which a canal boat could be placed either for loading or unloading, or in any case so as to keep it out of the main highway of the canal and prevent interruption to the traffic.

In most of our cities the sidewalks are more than ample for the pedestrian traffic, and taking advantage of this individuals have been allowed to encroach upon the sidewalk either with part of a building or with merchandise. It is now being demonstrated in New York City that by cutting off projecting parts of buildings which have heretofore encroached upon the public sidewalk, and restricting these buildings to their own house line, it is possible to reduce the width of the sidewalk and simultaneouely provide a greater width between the curbing, so that in some cases it has been possible to double the capacity of the streets—always provided, however, that the ever-present selfish individual does not appropriate to his own use this additional street space intended for the public.

It is impossible continuously to keep on widening the streets of a city. The cost is too great and it is unjust that the cost should be saddled upon the public generally when other means are vailable for reducing interruptions and obstructions.

There are many details that might be suggested to the engineers in charge. For instance, merely rounding the corner, unless the radius is adjusted to the particu-

lar situation, does not have any material effect upon enlarging the capacity of the street.

Everyone who has studied the problem of street congestion is familiar with the traffic maps and charts, which have been based upon actual observation of the number of vehicles passing a given point within a stated period. (Very little consideration is given to the number of pedestrians.) These traffic charts start with a thin line in the outskirts of the city; this line gradually increases in width until at the congested points the black line fills the entire width of the highway—indicating that there is no more capacity available.

Should Limit Size of Vehicles

I said the automobile is responsible for most of the congestion and I think the motor truck of undue size must assume a large part of the responsibility. The police officials of the world have their eye upon this situation, and at their recent conference in New York City adopted a recommendation fixing the maximum dimensions of an automobile or motor truck at 26 ft. in length; 8 ft. in width and 11 ft. in height.

Contrast this with the only slightly greater dimensions of a standard railroad box-car recommended by the Mechanical Division of the American Railway Association, i. e.

Length 40 ft., 9½ ins. over end sills;

Width 9 ft., 4¼ ins.;

Height from rail to eaves 12 ft., 5½ ins.

There is a constant and consistent effort on the part of the larger communities to keep railroad cars off the city streets, and I believe that one of the problems before the automobile manufacturers of this country is the regulation of the size of the vehicles, both for passenger traffic and for the handling of commodities.

It is not an uncommon sight to see a 5-ton motor truck devoted to transporting a package that could be handled easily on a wheelbarrow. A 7-passenger automobile frequently contains only one occupant. The vehicles now being constructed are rapidly approaching the limit of the capacity of railroad cars, and the carriers are being asked to construct special freight cars which are useful for no other purpose than to transport these large vehicles.

We are rapidly coming to what Dr. Inge called "the impotence of size." Our cities, our population, our vehicles, are all getting too big and because the cities are getting too big and because the population is too much concentrated, the whole scheme of distribution is changing.

Villages Will Not Be Business Centers

In the larger cities the rentals are so high that few merchants can afford to maintain sufficient storage space for more than two or three days merchandising, with the result that single-package consignments are becoming more and more numerous, and the large bulk deliveries are becoming less and less. This is sometimes called a hand-to-mouth policy of purchasing and sometimes considered an indication of poor business, but this is not true in every instance nor to any large extent. The automobile has revolutionized merchandising, but the provisions for making this new method of jobbing a success have lagged behind.

It is inevitable that the village and hamlet as business centers will disappear. The small communities will become residential places and will be a relief from the clamor and noise of the towns and cities, but this change will not be altogether voluntary.

In the classification of the inhabitants of the United States, the Census Bureau puts the communities of less than 2,500 people under the heading of "rural population," and a great deal of alarm has been expressed because there has been a movement in the last 15 years from the country to the city. This does not necessarily mean that the movement has been from the farm to the city. My own view is that while there has been a certain proportion moving from the farm to the city there has been a substantial movement from villages and hamlets to these communities, which are classified by the census as "urban" communities, i. e., larger than 2,500 people.

Automobile Brings Farm Trade to Cities

The cause of this exodus is the automobile, which permits the farming population of something over 30,000,000 to visit the larger towns with as much facility as they could formerly visit the cross-road settlement on foot, horseback or in a horse-drawn vehicle.

There was a time in the South when some of the cotton plantation owners insisted upon restricting the negro farmers to the use of oxen, instead of using horses or mules. The definite purpose of this was to prevent the colored help visiting the adjacent village or town after working hours. It was impossible to proceed fast enough with oxen to allow time

for any amusement before it was necessary to start on the return trip; a mule could be operated much more rapidly but a long trip at night usually put him out of condition for the day's work. I have not heard recently of any such contracts, because the automobile can be run all night and still be in good condition the next morning, barring accidents.

This change means that the smaller communities are getting smaller and the larger communities are successively getting larger. The improved highways which lead to the cities just as much as they lead to the country result in a concentration of vehicles in the city streets where congestion can only be prevented by preventing interruptions, and by regulating the size of the vehicles.

We are not alone in this problem:

The city of Buenos Aires, which has a population of nearly 2,000,000, is complaining that the motor buses, which were intended to relieve the situation, have increased the congestion, together with the increasing number of automobiles, and although they have adopted the system of restricting certain streets to one-way traffic, progress during the busy hours is so slow as to be described as "a snail's pace."

I think it was the city of Bristol, England, which recently refused to grant a license to a charabanc or sight-seeing bus *designed to hold seventy-two passengers.*

In the city of London they are seriously discussing the construction of underground parking spaces by excavating beneath the smaller city parks.

Yet in the whole of Great Britain there are only 1,067,000 self-propelled vehicles, divided:

329,000 motorcycles;
426,000 passenger automobiles;
207,000 motor trucks;
76,000 taxicabs.

Converting roughly the English money into the American equivalent, the average cost per license was:

Motorcycles	$13
Passenger vehicles	75
Motor trucks	103
Taxicabs	150

But it must be remembered that for passenger automobiles, the license for which is based on the horse power, the rate is one pound Sterling per horse power; so that an American automobile of 30 h. p. costs nearly $150 per annum; and the net result of this charge is to encourage the construction of small automobiles of 6 to 10 h. p. These small automobiles are really much more mobile than the larger American machine, and the small size assists in reducing congestion. It is not necessary to tell this audience that in several of the States there are more automobiles than in the whole of Great Britain.

By-Pass Highways Needed

The city terminal problem will be partially solved when we start effectively to build by-passes around the thickly settled communities. If you have had occasion to study the map of Brooklyn— a city which if it were not part of Greater New York would be the third largest city of the country—you would find that throughout the length and breadth of that community there is not a single through street connecting the outlying sections in any direction. Brooklyn is an aggregation of small communities. There is no opportunity of going around Brooklyn or through Brooklyn, with the result that much of the Brooklyn inter-city traffic comes across to Manhattan Island, using the streets of New York City proper and then passing back into Brooklyn over another bridge.

The same problem is being solved in England by the construction of new trunk roads. Some of those are built at a cost of millions of dollars by the public authorities out of the funds contributed from the license receipts above referred to, and it is now proposed to build one or more of these motor highways at private cost, charging a toll, and even at the moderate figures proposed it is expected the receipts will pay a substantial profit on the investment. Many of our own small cities are congested by the foreign travel moving over and through their streets, without stopping for purchases or refreshments, quite as much as by the vehicles of the *local* taxpayers.

The Solution of the Terminal Problem

I believe the solution of the city terminal problem is to be found:

First—In the elimination of unauthorized obstructions.

Second—In the maximum widening of streets which will be easily possible when property owners keep their buildings and merchandise within their own property lines.

Third—In restricting the size of vehicles allowed to use the city streets, as recommended by the policy officials.

Fourth—In the construction of by-passes or trunk roads around the thickly populated sections of the country, so that the through movement may be direct, as

is being done in England and on the Continent.

Finally—In the adoption by the railroads and the merchants of a system of distribution and collection through the use of the motor truck or horse-drawn vehicle between the railroad freight stations and platforms on the one hand, and the public warehouses and off-line freight stations of the railroad and the merchant's warehouse on the other hand.

Types of Rail-Truck Operation

There are several phases of this kind of service:

First—The store-door delivery which prevailed at one time in some of the Eastern cities but was discontinued because of the opinion of the Commission that the plan was subject to discrimination.

Second—The collection and delivery of freight between the railroad freight station, on the one hand, and the merchants' warehouses on the other hand, through the medium of public transfer company working under contract with the shipper, but with only a limited contract with the railroad company—the contract with the railroad company being restricted usually to establishing the responsibility of the transfer company.

Third—The above was the plan in vogue between East St. Louis and St. Louis before through rates to and from St. Louis were reduced to the East St. Louis basis and it then became necessary to effect an arrangement between the railroads and the transfer companies which is in practice today and under which the transfer company takes charge of the freight at the railroad station and delivers it direct to the consignee's warehouse or adopts the alternative of depositing the freight in a warehouse belonging to the transfer company, the St. Louis rates applying to and from such authorized transfer company warehouses. It was this method that the Erie Railroad adopted in New York but the arrangement at New York is not yet as general on the part of all lines as it is in St. Louis.

Fourth—The fourth method is the well-known plan of the individual draymen of serving one customer, or perhaps several customers, and trying to effect delivery or to make prompt collection of the freight to and from the railroad station. This class of service, because of its general nature and the difficulty of classification, is usually the least efficient, and results in the greatest congestion.

The situations at New York and at St. Louis are in a geographical sense almost identical, and while the service between the Jersey Shore and Manhattan Island is performed by ferries there will in the course of about 18 months be in service a vehicular tunnel which will have a great capacity and furnish an uninterrupted highway between the two states, in the same way that the Eads Bridge and the Municipal Bridge afford similar facilities between St. Louis and East St. Louis.

I have said that the automobile has assisted in changing the methods of merchandising throughout the country, but that facilities to expedite this system of merchandising had not kept pace with the new movement. I have in mind that there must be a correlation between:

(a) The railroad operations at the terminals;

(b) The public warehouses;

(c) The merchants of the community.

The Erie Railroad was the first to institute on Manhattan Island a system of terminal collection and delivery which took into account this combination of interests. We did not originate the plan because what we are doing in New York City is based upon what has been in effect in St. Louis for years.

Factors in Erie Experience

The factors which we took into account were the following:

First—The limited amount of pier space available on Manhattan Island and the impossibility of increasing this space without excessive cost, inasmuch as the city has raised many of the rentals.

Second—The impossibility of reaching by rail on Manhattan Island any larger area than now served from the water front.

Third—The limited area for storage purposes available in most of the consignees' warehouses.

Fourth—The desirability of associating storage warehouses with railroad terminals, so that surplus quantities, or quantities too large for the consignees' warehouses, might be handled safely and economically in public warehouses.

We believe that the intermediate or off-line warehouse is a necessity in New York City. We believe that a warehouse in connection with a railroad terminal is desirable in every city.

Uses of Warehouses

Under a prior arrangement made between the trucking company and the consignees, the freight which is unloaded

from the cars in Jersey City into the trucks of the transfer company is either delivered direct to the warehouse of the consignee, or, at his option, is delivered to an intermediate public warehouse to which the New York rates apply, just as the St. Louis rates apply to and from certain designated off-line warehouses in the city of St. Louis. The goods being delivered to a public warehouse may be stored at the option of the owner for an indefinite period at the usual warehouse rates and when so stored are not in the custody of the railroad company. When the merchant is able to receive the full consignment at one time, it is more economical for him to do so than to take advantage of the intermediate storage warehouse; but the transfer of freight between New York City and the freight car at Jersey City by motor truck, cannot be handled in any other way and give satisfaction to the shippers and consignees. When the direct delivery is desired the New York rate applies to Manhattan Island, but from the doorway of the ferryhouse to the warehouse of the consignee the charge is made by the transfer company and the cost is paid by the consignee over and above the freight rate to New York. The same arrangement applies in the reverse direction.

But in addition to providing the intermediate off-line warehouses for the accommodation of the shippers, we also felt we were preserving the identity of the independent truckmen or trucking company. In so far as the service between the inland, or off-line, warehouse in New York City to the car door at Jersey City is concerned, we necessarily made an exclusive contract; but after the goods reach the inland warehouse and are placed in storage, there is no exclusive contract between the railroad company and any individual trucking company, and the consignee is at liberty to employ any one of the facilities, or to use his own team or truck, as he sees fit.

The situation is the same on outbound business. The shipper is at liberty to use his own trucking facilities in making deliveries to the inland stations of the Erie R. R. in New York City, and upon delivery of his goods to such inland freight station the shipper receives an Erie bill of lading.

Reduces New York Street Congestion

We are assured by the Port of New York Authority that our method of handling freight to and from New York City is reducing the use of the streets of New York, and we therefore believe that a general adoption of the Erie plan by all railroads serving the city of New York would have a material effect upon the use of the streets and would necessarily assist in preventing congestion.

But much can be accomplished if the shipper and the consignee will enter into the proper arrangements with reliable trucking concerns to act as their agents with the railroad companies, because through this means the stations will be relieved more quickly and the full loads will be handled where only partial loads can be handled under individual arrangements. This plan is in vogue in Chicago and other cities.

Whether or not the majority of merchants desire the railroads to establish store-door delivery and collection, and to assume the entire responsibility throughout the entire transaction from door to door is a question which has not been settled definitely.

Simply because the collection and delivery system by the railroad companies has been generally approved in Great Britain, is not conclusive that it would be a satisfactory system in the United States. There is no point in that country more than 100 miles from salt water. A carload of freight in England is frequently no more than a small less-than-carload consignment over here. The conditions surrounding the collection and delivery, and especially the period of time between shipping point and destination, are so different that I do not believe we can learn much from their practices—not because I object to studying foreign methods but because I believe those particular methods are not adjustable to the United States.

Under the plan the Erie Railroad has adopted, and which we consider to be generally adaptable to the conditions in many other large centers, we have selected the best of all the methods in vogue. We do not claim originality—we simply claim to have been intelligent.

There is nothing new under the Sun except the radio and the automobile, and I am not entirely sure about those. The basis for railroad credit is the ability to handle passenger and freight traffic at a profit. Delays are not only dangerous but expensive and to the extent that we cut out delays, we believe we can increase our chances of profit and with an equal benefit to the merchants and manufacturers of the United States.

SEWAGE TREATMENT AT INDIANAPOLIS

The sewage disposal plant for the Sanitary District of Indianapolis was built by the Board of Sanitary Commissioners consistent with an Act of the Legislature of 1917, and is designed to treat the sewage of the city of Indianapolis and the town of Woodruff, which comprises the Sanitary District.

Construction work on main interceptors was begun late in 1919 and contracts were let in August, 1921, for the clarification or primary treatment plant, including the main pumping station, screen equipment, primary settlers, outfall sewer and connecting conduits.

On December 22, 1921, the Board authorized the construction of the activated sludge plant for final sewage treatment. This division of the work was designed in 1922 and active construction begun in the spring of 1923.

Plant Characteristics

The distinctive functional features of the plant are characterized by: (a) rapidity of operation, requiring less than seven hours from the time sewage reaches the screens until the effluent is discharged into the river; (b) removal of suspended solids in advance of biological treatment; (c) high volocities created and the effectiveness of spiral circulation in the bio-aeration process and (d) mixing of primary sludge with excess activated sludge and bacterial inoculation in the digestion of organic solids.

Pumping Station and Clarification Plant

All the sewage from the Sanitary District is received through the 78-in. interceptor located below and along the east side of the pumping station building. Liquids are first separated from the solids by fine revolving screens. Further separation takes place in the rapid settling tanks immediately south of this building. The thick sewage containing the solids, retained by the screens, flows by gravity to these tanks. The solids removed in the form of sludge are pumped for digestion treatment to the south end of the plant. Six electro-centrifugal pumps lift the screened and settled sewage about 20 ft. to the activated treatment plant.

Activated Treatment

The partially clarified sewage delivered to the activated treatment plant is first mixed with a considerable volume of biologically active sludge returned from the process. In the presence of aerobic bacteria thus introduced, the sewage is subjected to active aeration. The tanks used for this purpose consist of four channels, each 15 ft. deep, 20 ft. wide and about 250 ft. long. Along one side of each tank are diffusers or porous plates to which air is delivered under pressure of about 8 lbs. per sq. in. The diffused air carries up the mixture of raw sewage and the activated sludge until it strikes the overhanging or deflecting surface at the top which diverts the bubbling mass across to the deflector at the opposite side, then downward and across the bottom, completing the circulating spiral. This continuous circulatory and onward movement causes a complete and successive bacterial change in the sewage, reducing it from its putrescible elements to the purification desired. The length of spiral travel during the aeration treatment is approximately seven miles.

Activated Settlers

From the aeration tanks the treated sewage flows under the operating gallery to the octagonal settling tanks. These have conical bottoms and are about 20 ft. deep. The bottoms are continuously swept by loose chains which are moved slowly by the arms of a revolving shaft. As the activated sludge settles to the bottom of the tank the clear water flows over the regulating weirs into the steel troughs and out to the effluent channel along the north side of the plant and thence into White River. This water is clear yet not potable but is sufficiently stable for river dilution. The sludge which has settled into the cones is in part pumped back in a continuous circuit to the incoming raw sewage entering the aeration tanks. Excess over that required for this purpose is delivered to the digestion pits and after digestion and drying it is used as fertilizer.

Power Plant

Electric power for pumping and other use as well as air under pressure for sewage treatment is furnished from the main power plant. Coal for fuel is delivered to the power building, here it passes through crushers and is elevated to the bunkers, whence it is automatically weighed and spouted to the mechanical stokers. The boiler plant has a nominal rating of 2,000 horsepower but capable of producing more than twice that capacity. In the turbine room are two 500 kilowatt steam turbine-electro generators and one of 750. West of the electric units are three steam turbo-

blowers supplying compressed air for activated treatment.

Dehydration Plant

The construction work of the disposal plant in main is practically completed, except that required for sludge dehydration. In the digestion process, sludge will not be available for fertilizer until several months after it is produced. The part of the dehydration plant completed is designed to dewater either digested sludge or that direct from the activated settlers. Complete and final equipment for this purpose will not be provided until the relative efficiency of the two methods has been fully demonstrated.

Plant Capacities

In capacity, the interceptor system, pumps and the pressure conduits are designed for daily flows up to 120,000,000 gals., which is sufficient to take care of considerable storm water in addition to present sanitary sewage. The fine screens and primary settlers are designed for 72,000,000 gals. per day. The activated treatment plant is intended for an average rate of 50,000,000 gals. per day, or the estimated dry-weather flow for 1930. Provision is made in the construction of the screen plant and settlers also in the activated treatment plant for installing additional units as may be required.

Construction Costs

The plant as constructed serves a connected population of 300,000. The cost of construction of the entire system is about $3,000,000, of which more than $1,000,000 has been expended for intercepting sewers to correct conditions existing within the Sanitary District and to conduct sewage to the disposal works. The disposal plant cost, for population served, is approximately $6 per capita, which is the lowest for which there is a published record.

Russel T. MacFall, Frank C. Lingenfelter and Otto C. Ross constitute the Board of Sanitary Commissioners. Chas. H. Hurd is Consulting Engineer.

STATE HIGHWAY PROGRESS IN INDIANA

The Indiana state highway department built and graded 508 miles of roads, 224 miles of which were concrete, maintained 3,916 miles of highways, did work on $2,000,000 worth of bridges and added approximately 95 miles to the system during fiscal 1924 ending September 30, according to the sixth annual report of this department. Total departmental disbursements were $14,419,566, which includes $3,704,939 received from the federal government.

An outstanding feature of the report is the extremely low administrative and supervising costs, as this gigantic business so vital to the continued success and expansion of the whole state was carried on at less than 3 cts. on the dollar, meaning that of every dollar handled by this branch of state government, 97 cts. went into the highways for either new roads, maintenance, new bridges or repair of structures.

A summary of the year's work as prepared by John D. Williams, director, says:

A tabulation of the lengths of the different types of road surface on each numbered state highway shows that the state maintained 3,916.36 miles of highways. Of the mileage maintained by the state, about 940 miles are now paved or surfaced with some type of dustless top; 131 miles have an earth surface, practically all of which has been graded, and 2,846 miles have gravel or stone surface which is maintained by dragging. The 131 miles of earth roads are in Spencer, Parry, Crawford and Orange counties, all in southern Indiana.

Three was built, during fiscal 1924, 172.9 miles of grading, 224 miles of concrete, 51.4 miles of bituminous macadam, 26.5 miles of gravel and 33.7 miles of stone roads. In addition, 44.4 miles of old stone or gravel roads were virtually rebuilt as gravel road, and 127.5 miles of old stone and gravel roads were resurfaced with a heavy coat of stone, which virtually amounted, in many places, to rebuilding them.

The added mileage of the year consists of the following:

	Miles
No. 6 from Lebanon to Lafayette	31.33
No. 10 from Lyford through Rockville to Bloomingdale to one mile south of the Parke-Fountain county line	27.86
No. 10 from Dyer to south corporation line of Hammond	5.49
No. 28 from Washington to Road No. 4 west of Bloomfield	31.80
No. 43 in Hammond	1.29

Development of Traffic on State Roads

Motor bus traffic is increasing at a rapid rate. A tabulation of the bus lines operating within this state shows that

88 per cent of bus traffic is upon the state highway system, and that 70 per cent of state roads are used by bus lines. Truck traffic also is increasing very rapidly as well as pleasure cars, and in all, motor transportation is increasing 25 per cent annually. With this great augmentation of traffic, cost of maintenance of the ordinary gravel and stone road is not only increasing each year but the dust nuisance on these types is becoming greater. Even with our large expenditures of highway funds we are not gaining on the increase in traffic.

It is doubtful if the revenue under the present statute will be sufficient to combat the increased traffic on our highways, therefore with the present sources of revenue the state should not assume the maintenance, for the present at least, of many more roads not now in the state system.

Types of road constructed should be adequate for the kind and amount of traffic they will be called upon to bear. Much money has been wasted in cheap construction of both roads and bridges, and we are now maintaining gravel and stone roads that should be paved. The result is our maintenance costs on some roads are greater than the interest charge would be on an investment in pavement.

Indiana's policy of "pay as you go" is economically sound and should never be changed, but road development should be speeded up as rapidly as is consistent and as the needs for development of the state requires.

Revenues of the State Highway Commission

The net receipts for this year were $11,499,205.46, reimbursements $4,207,599.85, making gross receipts of $15,656,805.31, which, when added to the 1923 balance, made a total of $16,911,261.36 available during the year. The 3-to-10-mill levy formerly in existence was removed by the state tax commission, and while $759,730 came from this source for 1924 program, there will be no revenue from this source for 1925.

The importance of the state claiming its federal aid is not generally understood, and I feel that the responsible officials owe it to the citizenship of Indiana to secure as much federal aid as is possible that the funds in the United States treasury belonging to Indiana may be used in the construction of improved highways, and this money placed in circulation instead of lying dormant in the treasury at Washington, doing no one any good.

Indiana's credit of federal as of Sept. 30, 1924, amounted to $6,019,148.12, and to this will come a share from the additional appropriation of Congress of $150,000,000 for 1926 and 1927.

President Coolidge, in his first message to Congress, favored the continuation of the "Road Program," and on the basis of an appropriation of $75,000,000 annually for 1926 and 1927, Indiana will receive approximately $3,800,000 additional credit. It is therefore desirable that we keep pace with the federal government wishing to share the expense of Hoosier road building.

Federal aid can only be claimed as reimbursement on the basis of 50 per cent of the actual cost of bridges, and 50 per cent not to exceed $16,000 per mile on grading and paving. Thus in order to receive this aid from the government, Indiana must spend $19,797,908.24 in the construction of roads and bridges.

No part of federal aid is available for maintenance, and the approved specifications on roads of the secondary type are such that it is not practical to claim aid on other than grading and paving. Also, on many small construction jobs of both roads and bridges it is not practical to secure federal aid. The fact that in the past five years state appropriations have not been sufficient to absorb the federal aid available made it possible for the state to secure $3,704,939.89 federal aid during fiscal 1924.

The federal aid act provides for the designation by the states, with the approval of the U. S. Bureau of Public Roads, of a system equal to 7 per cent of the total highway mileage of the state. On the basis of 72,000 miles of public highways, Indiana is entitled to 5,040 miles in the federal aid 7 per cent system, and on this mileage only will the government participate in the construction of bridges and pavement. This mileage has been designated, of which 4,236 miles are at present in the state's system (3,916 miles of which were under active maintenance last year). The remaining should be added as rapidly as funds are available for its maintenance.

An adequate system of state highways will provide connected paved trunk lines to carry the heavy bus and truck travel

that is sure to increase as roads are provided and isolated sections of the state developed. This development of Indiana's resources will mean increased taxable wealth and should mean a proportionate reduction in tax levies.

We are for the greater degree of safety that can possibly be secured on state highways and already have gone far in providing grade separations and in the relocation of state highways to eliminate grade crossings with steam and electric railways.

The state highway commission is primarily a spending agency of the state, and it is our duty to maintain and build roads by spending all available funds, which can be judiciously and economically used, keeping ever in mind that we must have a dollar's worth of value for every dollar expended.

I should like to recommend that the counties most benefited by the development of state highways be required to furnish the necessary right of way for their construction. There is already a statute that permits contribution by counties and other municipalities to the state highway fund in road construction within the municipality.

Federal Aid Statement Sept. 30, 1924

Federal aid apportioned Indiana by year from 1917 to 1925 inclusive:

1917	$ 135,747.62	
1918	271,495.24	
1919	1,756,149.60	
1920	2,564,846.88	
1921	2,687,053.27	
1922	1,958,855.41	
1923	1,305,903.61	
1924	1,692,437.05	
1925	1,939,903.32	
Total		$14,312,392.00
Amount received to Sept. 30, 1924		8,293,243.88
Amount earned not received	$ 492,007.19	
Amount available not earned	5,527,140.93	
Balance available		$ 6,019,148.12
Aid apportioned prior to Nov. 8, 1921	$7,415,292.61	
Aid apportioned Nov. 9, 1921	1,958,855.41	
Aid apportioned July 5, 1922	1,305,903.61	
Aid apportioned Mar. 1, 1923	1,692,437.05	
Aid apportioned June 30, 1924	1,939,903.32	
Total aid apportioned Indiana		$14,312,393.00
Amount under project agreements		11,822,179.23
Balance to be placed under agreements		$ 2,490,212.77
Amount to be placed under agreement before June 30, 1926		550,309.45
Amount to be placed under agreement before June 30, 1927		1,939,903.32
Total apportioned to Indiana	$14,312,392.00	
Monies claimed to Sept. 30, 1924	8,293,243.88	
Our present credit with the U. S. Treasury		$ 6,019,148.12
Contemplated allotment available July 1, 1925		1,939,903.00
Contemplated allotment available July 1, 1926		1,939,903.00
Total credit to be available		$ 9,898,954.12

I should also like to recommend that the responsibility for bridges made necessary by dredge ditch construction be clearly defined and that it be made unlawful to cut through a state highway without provision having been made for the necessary bridges.

Expenditures

Total disbursements of $14,919,566.43 were made from the highway fund during the year, leaving an unexpended balance of $1,991,694.93. Of the total disbursements, $500,000 was returned to counties as apportionment of the gasoline tax. Amounts expended by each division follow:

Administration	$ 56,166.09
Construction	9,234,838.08
Maintenance	3,959,216.15
Equipment	1,169,346.11
Total	$14,419,566.43

The total supervisiong charge for the past year was $415,848.78 or 2.88 per cent of the total amount disbursed.

The average expenditures per mile per year for maintenance only on the state system, including its pro rata of general expenditures, workmen's compensation, and overhead was, for 1920 and 1921, $499.64; 1922, $500.24; 1923, $548.88, and 1924, $658.59—or an average cost per mile per year for the past five years of $546.35.

There is a noticeable increase in the yearly expenditures per mile maintenance which increase is in the item of surfacing and reflects the steadily increasing traffic which our highways are called upon to bear.

Total expenditures per year by the road department for grading, small structures and pavement, were as follows:

1921	$2,731,567.77
1922	2,316,075.65
1923	2,774,213.45
1924	5,609,003.93

The average cost per mile for concrete pavement, including grading and structures under 20-ft. clear span, for contracts awarded in 1919, $34,744.22; 1922, $28,665.49; 1923, $29,878.96; 1924, $30,161.76.

The total amount expended for the construction of bridges since organization of the bridge department is $2,309,639.60 and this work was done on a total of 175 federal aid structures and 204 others, bridges being located in fifty counties. During the five and a half years existence of the highway department, contracts have been awarded for 379 bridges of 580 separate spans and a total clear span opening if joined together of 5.10 miles of waterway.

FRIDLEY CONDUIT OF ST. PAUL WATER WORKS

By J. W. Kelsey, General Superintendent and Engineer, Water Department, St. Paul, Minn.

The Fridley Conduit is the name given a 60-in. internal diameter steel and reinforced concrete conduit, serving to convey water from the Mississippi River in Fridley township directly east, a distance of eight miles, to Charles Lake. (Charles Lake is one of the lakes of the present water supply for the city of St. Paul and is located approximately eight miles north of the city limits.)

Need for an Additional Water Supply

In 1910 the City of St. Paul experienced a water shortage on account of subnormal rainfall. Therefore, in 1911 the Board of Water Commissioners, upon the advice of Dabney H. Maury, consulting engineer, drilled six 12-in. wells about 700 ft. deep at the McCarron pumping station, and 18 wells 63 ft. deep and 10 wells 400 ft. deep at Centerville. The capacity of the six McCarron wells is approximately 6,000,000 gals. per day. The Centerville wells also have a capacity of about 6,000,000 gals. per day. In 1911 the rainfall, amounting to approximately 41 ins., replenished the lakes and the wells were not used until 1921. Thus, with these wells in reserve, the Board felt fairly well fortified against a water shortage.

However, consumption of water in the city was increasing and the lakes—while full—showed upon careful investigation that less water was available than formerly. Therefore, it was realized that the supply should be increased.

In July, 1920, all the water supply lakes were full and water was wasting over the dam at Peltier Lake. The Water Board, however, consisting of Commissioners McDonald, Wenzel and Matson, was convinced that it was time to do something toward obtaining an additional supply, so a $3,000,000 bond issue was voted upon and passed in November, 1920.

Available Sources of Supply

Four sources of supply were considered, viz.: The Mississippi River, the St. Croix River, an underground supply, and a reservoir impounding the Rice Lake system by means of a dam across Rice Creek at the outlet of Baldwin Lake.

The St. Croix River project was fairly out of question because of the first and the operating costs. The mean difference in elevation between the distributing reservoirs in the city and the St. Croix is 343 ft., with an added head of approximately 80 ft. for pipe friction loss. The distance between the St. Croix and Deep Lake, tributary to Pleasant Lake, is about 18 miles. (Pleasant Lake was the nearest point in the present lake system.) It might be that at some future time White Bear Lake could be used as an intercepting lake for water from the St. Croix, which would maintain the lake water levels.

Ground Water Supply

The source of water for deep wells is probably through the permanent lowering of the ground water level throughout the large area from which water is drawn. Also, the interception of water naturally flowing to the Mississippi River is now being intercepted by the wells from an area somewhat larger than the area naturally flowing to the Mississippi River at St. Paul, this area extending probably as far north as Vadnais Lake or Centerville. Further, a small amount of water comes very slowly

from more remote sources and probably is not an important part of the whole supply.

The well supply source was abandoned because of the following:

First, because of its hardness it is an inferior water for domestic, commercial and industrial purposes.

Second, the cost of pumping and distributing it would be quite high.

Third, due to its limited quantity it did not appear to be a safe development for an absolutely dependable supply. In fact, records of existing wells show it to be a diminishing supply, which increased demands would greatly augment.

Rice Lake Impounding Reservoir

The terrain surrounding the seven lakes comprising the Rice Lake system is extremely flat. At best a dam at their outlet could form only a shallow lake of large area. The shallow water would encourage prolific weed growth and the evaporation would be great, especially in dry years. So, during years of subnormal rainfall, resulting in increased consumption and a decrease in available water, the situation would not be good and could hardly be called dependable. Further, it would flood a large area of hay and tillable land which would necessarily have to be purchased, so the cost, with the other objectionable features, practically eliminated this source.

The Mississippi River Source

The decision to obtain the additional water supply from the Mississippi River was adopted because it was so evident that it was the most dependable, the least in cost, and the most feasible. Further, the operating costs would be less than from any other source.

A supply from the Minnesota River was not given a great deal of consideration because of its location in respect to the city. The fact that St. Paul had an existing water works system well located was of great influence. As is generally known, the Vadnais Lake system, consisting of Charles, Deep, Pleasant, Sucker and Vadnais Lakes, lies directly north of the center of the city, at an elevation of 188 ft. above the city zero datum. This allows for an economical distribution of the water, reduces the extent of the feeder mains, and also reduces pumping costs. Further, a compact system lends itself to lower operating costs. The Minnesota River meant a division, a duplicate supply, or a complete change-over at great cost.

Conduit

The entire project, including the conduit, the pumping station, pumping equipment. canal between Charles and Pleasant Lakes, and the standpipe, was termed the Fridley Conduit.

The capacity of the conduit in the preliminary plans was fixed at 40,000,000 gals. daily. This seemed ample when it was considered that the average daily consumption in the city does not exceed 24 m. g. d., and that the lake system normally will produce 15 m. g. d., with the well system in reserve. Later the capacity of the conduit was increased to 60 m. g. d., as a medium between first cost and future needs.

Wood stave, cast iron, steel and reinforced concrete were considered as the material of which the conduit could be constructed. A continuous wood stave pipe would have entailed the lowest first cost by a wide margin. Soil conditions, however, eliminated it. Much of the right of way is of peat formation and slightly acid, which would have been detrimental to the steel hoops. Practically all the balance of the ground is almost pure silica sand, which was not best for untreated wood. Although creosoted treated wood has been used successfully for waterworks, we were a bit afraid of tastes in the water. Further, soil conditions were such that it would have been difficult to have obtained good workmanship in the invert.

Cast iron pipe was prohibitive due to the cost.

Steel pipe coated with a special coating of a semi-rubber base was used for the first 8,150 ft., where the head was comparatively high. First cost, anticipated useful duration, maintenance, leakage, soil conditions, dependability under railroad tracks, were taken into consideration in making the decision.

The balance of the conduit, a distance of 33,107 ft., is of reinforced concrete. Reinforced concrete was less in first cost than steel and about double the cost of wood stave pipe. However, when soil conditions, internal pressure, maintenance, length of anticipated service were considered, it was evident that it was the best proposition for the greater portion of the conduit.

Pre-cast concrete pipe against pouring it in place in the trench was considered. The Lock Joint Pipe Company of Ampere, N. J., and the Independent Pipe Company of Indianapolis submitted fig-

ures for pre-cast concrete pipe. However, soil conditions, with unsatisfactory and difficult delivery of the pipe along the line and the placing of it (necessitating a heavy crane) were such as to make its cost prohibitive.

Therefore, all things considered, it was decided to use Blaw-Knox steel forms and pour the conduit directly in place. It can hardly be called monolithic for the reason that joints were placed every 20 ft., and the invert was poured separately from the crown portion. The conduit has an internal diameter of 60 ins., with walls 6 and 8 ins. thick. The 6-in. walls were used where soil conditions were good and the internal pressure low; otherwise, where the pressure exceeded 35 ft. or where the foundation was such that settlement would be expected, 8-in. walls were used. Also the 8-in. walls were used where the conduit was supported on piling.

Construction difficulties were very much increased due to the fact that water, quicksand, or peat bog was prevalent for approximately 6½ miles out of the eight. Innumerable springs were encountered, which were not apparent from test pits. In places yellow sand would boil upward through as much as 2 ft. of blue sand.

Through the peat bogs, a distance of 6,700 ft., piling was driven. The bogs at places were extremely deep and soft, 50-ft. piling being required in some instances. The piling, too, at times, sunk as much as 37 ft. under the weight of the hammer before a blow was struck.

Construction Joints

A great deal of thought was given to a suitable construction joint. The one we adopted is proving very satisfactory, but it is not 100 per cent perfect; it is perhaps as nearly so as one could expect. It consists of copper ring, 9 ins. wide, placed in the center of the concrete wall. Then on the inside face of the conduit ring there was molded by means of an aluminum form a depression 1 in. deep with a center groove V-shaped. This groove was then filled with a soft asphalt and the 1-in. depression was filled with a cement grout reinforced with hardware cloth. The idea was to permit movement and still have it water-tight. Then over the grouting was placed asphalt and a layer of saturated cotton fabric.

Our decision to make the joints every 20 ft. was based on experience and practice in other places. A monolithic construction was considered as was done on the Los Angeles aqueduct, and also placing the joints at 40 ft. However, the experience of the writer in similar work in the Reclamation Service and the experience of others made it seem feasible to place the joints at 20-ft. intervals.

Extensive tests have been made on concrete conduits by the New York Board of Water Supply, and they found that the leakage was almost entirely through construction joints, with a progressive diminution in amount with lapse of time entirely independent of the temperature influence. They also found that even in the best of concrete work there were occasionally porous places, especially where the walls are comparatively thin. However, using a 1:2:4 proportioned concrete with an addition of hydrated lime to the extent of 10 per cent by volume of the cement and with a minimum actual mixing of 1½ minutes in the mixer, a very dense concrete was obtained. In only one day's pouring was there any evidence of porosity. This occurred just west of Hamline Avenue, which resulted in several small leaks. These leaks are diminishing, and are so small that it is not felt any money should be spent at present in fixing them. However, it is thought that a coating of a heavy asphalt paint on the inside of the conduit where the leaks are would stop them.

There also were some joints that leaked, but they have been practically all repaired, and none was serious.

The longitudinal joint between the invert and the crown section has given no trouble. In fact we have yet to discover leaks from this source. A very simple joint, consisting of a groove in the invert, was used. The steel forms for the crown section permitted grout to flow down over the joint, which aided in sealing it.

By means of a Price current meter and also with floats we have endeavored to measure the leakage. The pumping station is equipped with a Venturi meter, and as far as can be ascertained by the methods of measurement used the leakage is negligible.

We did not bulkhead the outlet of the conduit and measure the leakage by displacement from a tank, believing conditions did not warrant the cost and danger of damaging the condit.

Air Valves and Surge Tank

Air valves were placed on the high points. Some are automatic and some

manual. On the steel pipe to prevent collapse from sudden emptying a 6-in. automatic air valve is in service as well as a 6-in. check valve.

A steel surge tank, 12 ft. in diameter and 98 ft. high, was placed in the conduit line on the crest of the river embankment about 150 ft. from the pumping station. This tank is open at the top, and its function is to reduce vibration in the pipe line, steady the flow of water, and to prevent damage from water hammer when the power fails suddenly.

Pumping Station and Intake

The pumping station, 50x60 ft. in plan, and the intake, 27x41 ft. 6 ins. in plan, are housed under the same roof. The building is supported on piling and was made heavy enough to resist buoyancy from the water.

Considerable difficulty was encountered in the construction, due to the fact that the station is at the foot of a 60-ft. embankment. A cofferdam was constructed and the excavation carried down 10 ft. below low-water level in the river, or approximately 25 ft. below ground level on the embankment side. The pressure from the embankment was hard to resist, due to lack of a suitable support on the river side.

The intake extends out into the river with a floor elevation about 5 ft. lower than low-water level in the river.

There are three intake openings with sluice gates and trash racks.

Also, inside the building are three traveling screens having a screen mesh of ⅛ in.

Two pumps are now in operation. They are of the electrical motor driven centrifugal type of 10 and 20 million gallon capacity per day. Provision was made for the installation of additional pumps to increase the capacity of the station to 60,000,000 gals. per day when necessity demands.

The conduit was designed and constructed under the supervision of the writer and Leonard N. Thompson, senior assistant engineer.

The foregoing article is from the July issue of The Bulletin of the Minnesota Federation of Architectual and Engineering Societies.

SHIPPING PIPE BY AIRPLANE

The fact that 117,000 lbs. of iron piping and fittings will be transported by airplane from Iron mountain, Montana, to a placer mine in the Clearwater region of Idaho, is attracting national interest, according to Ive McKinney, of Medford, Ore., who has the contract for this unique transportation.

Mr. McKinney explains that he will use two planes to transport the metal over the high mountain range to the placer mine.

This is being done by the mining company to save time, and actually six months will be saved by using the air transportation method rather than that of the mountain trail and slow-going pack trains.

A landing field has been prepared on top of Iron mountain large enough to accommodate any plane for landing purposes.

TESTING BITUMINOUS MATERIALS

By B. H. Piepmeier, Chief Engineer, Missouri State Highway Commission, Jeffferson City, Mo.

Bituminous material is material which contains bitumen as an essential constituent. Bitumen is a mixture of hydrocarbons and their non-metallic derivatives, soluble in carbon disulphide. Bitumen may be in the form of a gas, a liquid, or a solid, and it comprises the greater part of petroleum, asphalt and tar products.

There are two main classes of bituminous materials—those consisting of asphalt or petroleum products and those consisting of tar products.

With but few exceptions, the crude bituminous materials contain impurities and for this reason and in order to obtain the desired consistency, a manufacturing process of some nature is necessary. The most common processes for the production of bituminous products for highway use are distillation, oxidization or blowing, fluxing and mulsification. Two classes of products, distillates and residues, are formed by distillation. Distillates are generally rather thin liquids possessing limited binding properties, while the residues grade from liquids to solids, according to the amount of distillate removed. Water and the more volatile consituents of petroleum are generally removed by distillation, although the same result may be obtained by "topping" or heating in a coil to develop pressure and then allowing sudden expansion to eliminate the water and vola-

tile matter as steam or vapor. By blowing air through fluid residues at the proper temperature, an oxidization takes place which produces a material of heavier consistency, having less ductility, a higher melting point, and less sensibility to temperature changes. Material so produced is called blown asphalt.

Fluxing is the process of softening a solid or semi-solid material by the addition of a liquid bitumen. Most fluxes are fluid residues, but in some cases, distillates are so used and the resulting product is called a cutback. Cutback products rapidly return to a heavier consistency while other fluxed material tends to retain its fluxed consistency. Emulsified bituminous materials are those to which a saponifying agent or soap has been added in order that they may be mixed in varying proportions with water to obtain the desired consistency. This class of material is very seldom used in highway work at present, on account of its inability to stand storage.

The proper control of the temperature of bituminous materials during application is very important. Specifications generally state the temperature to which a material may be safely heated. Prolonged heating above this temperature will result in a loss by volatilization of lighter constituents and a consequent hardening of the product. Excessive heating will also cause local decomposition by cracking or coking. If raised to a sufficiently high temperature most bituminous materials will ignite and burn. It is sometimes necessary to heat the mineral aggregate, sand, and stone, which is to be combined with the bituminous binder. Equal care should be taken to avoid overheating this material, as the bituminous binder is exposed in very thin layers to the hot aggregate and is more easily injured while in this condition than if exposed to equal heat in a tank or kettle.

The presence of a very small amount of water in bituminous materials before use may seriously interfere with their application. Considerably less than one per cent of water will cause the material to foam violently when heated above the boiling point of water and it is a very tedious process to remove the water by a sufficiently slow process to avoid the danger of foaming. In the case of material shipped in tank cars having leaky steam coils for heating purposes, it may be necessary to reject the material rather than chance the loss and trouble due to foaming. Water is very easily removed from the tops of containers of hard bituminous material by means of sponges.

Many shipments of material are made in barrels with clayed staves to facilitate stripping in the case of the harder products. Such containers, as well as metal drums should be stored on their ends, as the slow deformation of the hard products under temperature changes will otherwise cause deformation and bursting of the containers.

Practically all asphalt, natural or manufactured, originated from petroleum. There are three classes of petroleum according to chemical composition, paraffin, semi-asphaltic, and asphaltic. The paraffin crude petroleum has a greasy but not sticky base, because of the predominance of the paraffin hydrocarbons. The asphaltic petroleum has a sticky or adhesive base, owing to the predominance of the asphaltenes or unsaturated hydrocarbons. The semi-asphaltic, from its nature, seems to be a mixture or mid-point between the other two classes.

Paraffin petroleums are used in highway construction for dust laying purposes or for the fluxing of asphalt. The asphaltic and semi-asphaltic petroleums furnish the main source of asphalt production. Asphalt or asphalt-cement produced from petroleum is practically pure bitumen, while the native asphalts obtained from lake deposits sometimes carry a high percentage of mineral and organic impurities.

If an asphalt is of proper consistence for mixing with aggregate, it is generally referred to as an asphaltic cement of A. C. If too hard for use, the common designation is refined asphalt or R. A. The native asphalts are generally too hard for use in their original form for highway work, and must be combined with a flux before they are suitable for use. The bitumen content of a fluxed native asphalt may be practically identical to an asphalt cement produced by the distillation of petroleum. Blown products, however, differ materially in their physical properties, generally exhibiting a marked increase in melting point, a reduced ductility and a lower penetration than the original product from which they are produced.

The most common sources of petroleum asphalts for use in this country are the Mexican and California petroleums, from which asphalt is obtained by simple distillation and the Texas and mid-continent petroleums, which require blowing or other special treatment to-

gether with distillation. The most common native asphalts are from Trinidad and Bermudez, the former containing about fifty per cent bitumen and the latter about ninety-four per cent. Small quantities of solid bitumen, mined in the form of Grabamite and Gilsonite are used in combination with blown oils and asphalts.

Rock asphalt is limestone or sandstone impregnated naturally with asphalt. It is produced by quarrying and is then crushed and rolled to size.

Tars are generally a by-product from the destructive distillation of coal in the manufacture of gas or coke or from petroleum products in the manufacture of water gas. Tar products are very different from asphalt products, both chemically and physically. They react more easily to changes in temperature and tend to harden rapidly on exposure to the atmosphere. For these reasons they are not considered as well adapted for fine aggregate bituminous paving work. Some of the distillates from tar products are known as creosote oils and are among the most efficient wood preservatives in use at the present time.

In the use of bituminous materials for highway work, the main precautions to be observed are: to see that the correct consistency of material is used, to avoid overheating during application and to use just sufficient of the material to bind the aggregate. The consistency for use in penetration macadam work can be softer than for use with the smaller sized aggregates as in the asphaltic concrete or sheet asphalt types. In general, the finer the aggregate to be used, the lower the penetration of binder. This is because the finer aggregates do not key, and, therefore, have less inherent stability than the coarser aggregates and for this reason require a harder cement to prevent motion of the aggregate. The most desirable penetration of asphalt cement for the different types of pavements will vary according to the nature of material used for a binder and also with the temperature conditions to be met. Overheating, as stated before, will result in a cracking or coking of the material with a loss of stability and binding properties. The use of too small a percentage of binder will result in a poorly bound dusty surface, which will ravel and wear rapidly. Excess binder will promote a wavy and unstable surface such as may be noticed in connection with the fat spots present in most bituminous penetration pavements.

In connection with the testing of bituminous materials, the interrelationship of the various characteristics of bituminous material is often more important than the result obtained from a single test. This fact complicates the interpretation of test results very much and care should be taken to avoid passing snap judgment on material on the basis of a single test characteristic.

If practical, bituminous materials should be sampled at the manufacturing plant. If this procedure is not followed, quart or two pound samples should be furnished to the laboratory from each shipment. Additional samples should be furnished if any overheating on the job is suspected. If a material is held in kettles at high temperatures for long periods, daily samples should be tested for consistency. Care should be taken to see that sample cans are clean and dry and if cleaned by use of kerosene or other liquid, they should be wiped thoroughly before being used. If the material to be sampled is in a fluid state in a tank car, a composite sample from top, bottom and middle of the tank should be obtained. Samples may be obtained from below the surface by lowering a stoppered container to the desired level on a stick or wire and then pulling the stopper by an attached string. Cold material in car lots should be heated in order that representative samples can be obtained. Samples from small packages of solid material can be obtained by cutting with a hot shovel or other metal implement.

In sampling solid material, care should be taken to obtain the sample at least three inches from the surface. Considerable shrinkage occurs on cooling in the package and the packages are then topped with material which may or may not be the same as the original material.

ASPHALT MEN TO HOLD CONVENTION IN DETROIT

Asphalt paving contractors, engineers and material men, as well as public officials from all parts of the United States and Canada will gather in Detroit, October 21, 22 and 23 for the Fourth Annual Asphalt Paving Conference under the auspices of The Asphalt Association, the national trade organization of that industry. The three previous meetings of the kind were held at Atlanta in 1922, Denver in 1923 and at Louisville last year.

Invitations from the Mayor and from various civic and commercial bodies of Detroit to meet in their city this year were accepted at a recent meeting of the directors of the association.

In line with the growing national sentiment for greater economy in highway construction the Detroit conference, according to J. E. Pennybacker, general manager of the Asphalt Association, will devote considerable attention to surface treatment for roads so as to adapt the cheaper types of pavements such as sand clay, gravel and macadam to sustaining traffic without a large initial outlay of highway funds. Considerable discussion also will be devoted to the possibility of salvaging old gravel and macadam highways by utilizing them as bases for asphalt pavements.

"These questions," said Mr. Pennybacker, in outlining the plans for the conference, "are now uppermost among paving officials and engineers and by utilizing the old roads as bases many millions of dollars can be saved to the counties and states without sacrificing progress in road improvement. Another subject that will be discussed will be that of increasing the stability of sheet asphalt pavements so that, without additional cost, they will sustain, without any deformation whatever, the heaviest motor truck traffic. Our research department under Prevost Hubbard, formerly chief of research, United States Bureau of Public Roads, has been conducting experiments with a view to determining ways and means of increasing stability for sheet asphalt pavements and has developed some exceedingly practical results which will be presented fully to the convention."

During the past five or six years, according to Mr. Pennybacker, the growth and expansion of the paving industry has been so rapid that the yardage of asphalt pavements laid annually has increased from about 50,000,000 sq. yds. to 125,000,000 sq. yds. This year it is expected that the asphalt paving laid upon the roads and streets of the country will approximate 140,000,000 sq. yds. This expansion has emphasized the importance of the adequately equipped and trained asphalt contractor. "At present," said Mr. Pennybacker, "the competent contractors engaged in laying asphalt pavements are not distributed so as to meet the demand for asphalt street and road construction. We need a better distribution of asphalt contractors as well as more asphalt engineers and this will be another of the several important matters to be considered at the meeting in Detroit."

The Asphalt Association has had greatly to expand its own activities during the past few months. A new district office has just been opened in the Whitney Central Building at New Orleans with Bruce Aldrich in charge. This office will cover Louisiana, Mississippi, Alabama, Arkansas, Texas and Western Tennessee, assisting the state, county and city highway departments in solving paving problems without charge throughout that territory. In addition to the New Orleans office the association now has district offices at Albany, N. Y., with Vibert L. Ostrander in charge; Charlotte, N. C., with L. D. Smoot in charge; Chicago, with George W. Craig in charge, and at Kansas City with H. C. Smith in charge. New Jersey and Pennsylvania are handled by W. E. Rosengarten from the New York office. Canada is looked after by F. C. Field and Georgia by W. A. Crossland at Atlanta. W. C. Ricketts is assigned to the state of Florida. Two new men have lately been added to the Chicago office in James and Wallace Craig, both of whom are experienced asphalt men.

In addition to creating new district offices and expanding the forces working from the older ones the association recently established a fully equipped paving laboratory at White Plains, N. Y., 22 miles from New York City, with Prevost Hubbard, chief of the research department in charge.

During the past two years the association has grown considerably in membership and has been compelled to expand the working force in its general offices in New York as well as seek larger quarters. Because of this the general offices have been moved from the National Association Building, 25 West Forty-third Street, to the new Railway Building and Loan Building, 441 Lexington Avenue at Forty-fourth Street, New York, where the association now occupies practically twice the floor space that it did.

Bruce Aldrich who has assumed charge of the office at New Orleans, received his original training as an asphalt paving expert with the engineering department of the District of Columbia and as asphalt paving inspector for the City of Baltimore. During the World War he served in France as a Captain of Infantry, A. E. F. Upon his return from the war he took charge of the Asphalt Associa-

tion's Canadian branch in Toronto, later resigning to enter private engineering practice. It was only recently that he rejoined the staff of the association.

MASSIVE WET SOIL FOUNDATIONS FOR A GREAT STEAM-ELECTRIC POWER HOUSE

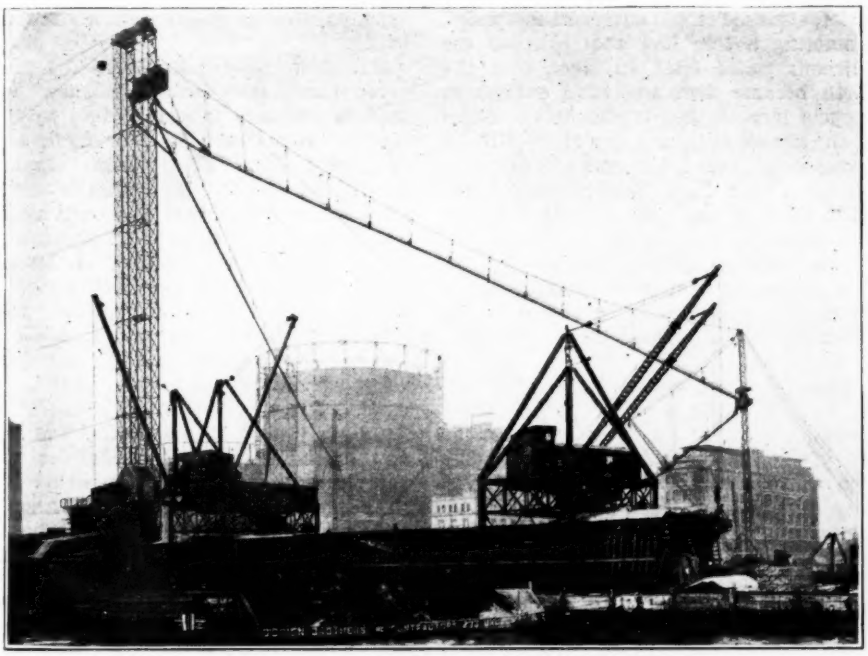
By Frank W. Skinner, Consulting Engineer, 20 Vesey St., New York, N. Y.

At a cost of more than $25,000,000 there is now being built at 14th St. and East River, New York, the first part of a 720,000-h.p. steam electric generating plant for the New York Edison Company. It was designed by Thomas E. Murray, consulting engineer, and is constructed under the supervision of the Edison Company, E. M. Van Norden, engineer; by the Ken Well Co., general contractor, F. E. Cudworth, superintendent.

The main buildings, about 130 ft. high, will cover an area of approximately 200x600 ft. on both sides of Ave. D, and will rest on continuous concrete foundation slabs 15 ft. thick supported by about 18,000 untreated yellow pine piles with an average penetration of about 30 ft., through the saturated soil which in some places contained many large stones, boulders and buried timbers, and into a stratum of hard sand and gravel.

Since more construction may be involved as the plans are developed, work may be in progress for two years or more, and the contractor at first erected large and substantial buildings for office, store house and shops, and installed a costly system of bins, conveyors, derricks and aerial chutes for unloading, storing and handling materials.

The concrete equipment, selected, arranged and installed by the contractor's staff, assisted by the R. E. Brooks Co., and Ginsberg-Penn. Co., was designed to include the best features of eight alternative plans intended to provide maximum safety, continuity of operations, rapidity and efficiency of service, simplicity of equipment and operation, final salvage with minimum maintenance and total costs. It cost about $60,000, is made as much as possible with standard appliances, and consists essentially of gantry derricks unloading aggregate, belt conveyors and bucket elevators supplying it to the mixers; slat conveyors transporting cement bags for unloading, storage and reclaiming; twin concrete mixers



BUCKETS OPERATED BY STEEL GANTRIES UNLOADING SAND AND GRAVEL FROM SCOW TO 3,000-YD. STORAGE BIN. CONCRETE HOISTING TOWER 240 FT. HIGH AND AERIAL SPOUTING SYSTEM IN BACKGROUND.

and a system of hoisting concrete to a sufficient height to spout it by gravity to two distribution centers from which it can be chuted by sub-systems of pivoted counter-weighted trusses to all parts of the buildings with overhead clearance for any other construction simultaneously carried on alongside of the concreting.

About 110,000 yds. of material were excavated by two ¾-yd. steam shovels working in two lifts to subgrade about 16 to 18 ft. below the original surface, and in the tunnel trenches below that level by three 1-yd. Hayward buckets. The ground was so wet and soft that it was by some considered that steam shovel work was impracticable and that drag lines, or bucket excavation, would be required for a great part of the excavation. To avoid this heavy expense, the contractor, the Thomas Crimmins Contracting Co., F. L. Benedict, chief engineer, drained the surface thoroughly with ditches discharging to sumps at first emptied by portable gasoline pumps. As the excavation progressed the ditches were led to a single deep sump near the river end of the lot. Much of the heavy seepage from the river was intercepted by three lines of steel sheet piles parallel to the bulkhead line and the remainder was largely collected at the sump which it entered through a mass of broken stone which enclosed it and covered the bottom, promoting a free flow that lowered the adjacent water table so much that the earth became firm and hard enough to support large loaded trucks on the edges of the shovel cuts, and the shovels themselves only needed, in some places, to be provided with light wooden pads taken up in the rear and laid in advance by the dipper booms.

The large sump was drained by two 8-in. Kingsford centrifugal pumps, one of which was usually kept in reserve while the other seldom was required to operate at full capacity.

The steam shovels worked very steadily and efficiently, no time being lost by breakdowns, and the best record being 755 yds. for one shovel in one 8-hr. day. The shovels were very efficiently served by a fleet of 5-ton Mack motor trucks entering and leaving the pit over a planked ramp and maintaining a continuous performance that kept the shovels steadily working without loss of time waiting.

Foundation stones and boulders too large to be handled by the steam shovels were drilled with jackhammers operated by air from a portable gasoline driven Chicago Pneumatic Tool Company's compressor, and blasted with light charges that broke them up to pieces handled by the ¾-yd. dippers. The compressor which was only required to run intermittently was found very convenient, easily moved and operated and efficient.

Below the general subgrade two trenches for long, 11x20 ft., condensation water tunnels were excavated to an additional depth of about 13 ft., involving about 30,000 yds. of earth handled by three Hayward 1-yd. clamshell buckets, operated by the long booms that replaced the dipper booms of the steam shovels which then acted as locomotive cranes, and also handled the two 7-B and two 9-B McKiernan-Terry steam hammers that drove about 40,000 sq. ft. of steel sheet piles to retain the sides of the trenches and other vertical earth faces. These hammers delivered 225 and 140 blows per minute with energies of 4,150 and 7,727 ft.-pounds per blow, respectively, at a maximum rate of 40 sheet pile units up to 40 ft. long, by one hammer in one 8-hr. shift, afterwards pulling them with special harness when tackles did not suffice. These, and the other steam hammers, were operated by steam chiefly derived from the boilers of 12 Lidgerwood heavy duty hoisting engines installed on the pile-driving rigs and derricks, and supplemented by steam from a stationary boiler.

The foundation piles were driven by seven heavy duty steam hammers operated in standard land machines by locomotive cranes, and in four 32-ft. leads suspended from two 2-boom travelers moving across the full width of the lot on a broad gage track, and each able to drive about 1,100 piles from a single position and to move forward to the next position in a very few minutes. The traveler booms had long radius, could reach over obstructions and operated the hammers when excavation and other work was in progress close to the travelers. They were also very useful for handling piles and pile butts, and were an important factor in the increased rapidity and economy of the work. The piles were driven on a sub-contract by the P. T. Cox Contracting Co., who employed an average force of about 55 men, and installed five McKiernan-Terry 9-B double-acting steam hammers that made a record of 250 piles in one day. Two of the land (tower) pile drivers, were equipped with No. 2 Warrington-Vulcan steam hammers with 3,000-lb. rams and

36-in. strokes, that in spite of delays in handling piles and reaching difficult positions, drove as high as 67 piles per hammer in 8 hrs. The bearing capacity of these piles was computed by the ordinary Engineering News formula. Most of the 18,000 piles were driven to refusals of less than 2¾ ins., for the last 10 blows. The piles penetrated to a stratum so dense that 100 blows were often required for the last inch.

The concrete and pile formation bulkhead and the 26x172-ft. intake and screen chamber are being built, under separate contract, by the Phoenix Construction Co., who have done a large amount of dredging and will place the concrete in deep water in cofferdams involving the driving of about 3,000 tons of 14-in.-35-lb. arch web Lackawanna steel sheet piles from 30 to 65 ft. long.

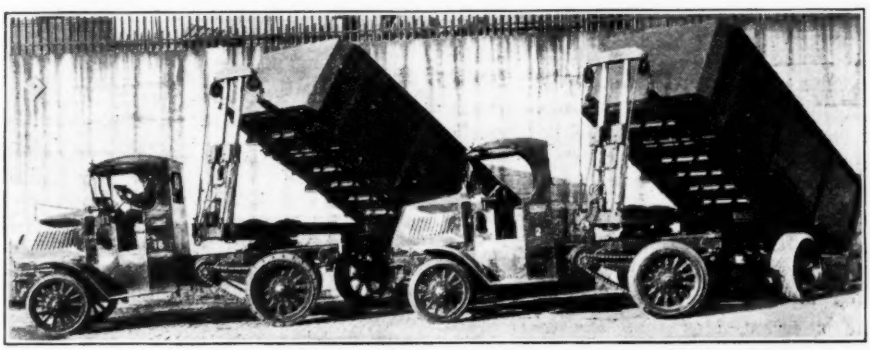
About 900,000 bags of Atlas cement, received by the scow load, are delivered from the slip to the storage house by conveyors that also carry it up to an elevated platform, from which it is chuted as required to the charging platform of the concrete mixers. The conveyors are speeded so as to deliver exactly the proper amount of concrete to keep one or both of the mixers in continuous operation, when the bags are placed on them at convenient regular intervals. The storage house has a capacity of 25,000 bags and the cement is handled by two or four men in it according to the distance the bags are piled from the conveyor.

Aggregate, received on scows, is rapidly unloaded by three Blaw-Knox clamshell yard buckets operated by four derricks mounted on gantry cranes equipped with two Clyde and two Lidgerwood 75-h. p. hoisting engines. The gantries move on a long track, commanding, between its rails, a 3,000-yd. elevated storage bin, with bottom gates discharging on a belt conveyor which, in combination with a bucket elevator, and a short overhead distributing conveyor fills the elevated mixer bin. Both bins are provided with perforated pipe coils for steam heat in cold weather. All conveyors for cement and aggregate are of the Haiss type, driven by about 25 interchangeable 5, 10 and 15-h.p. motors including one extra of each size to provide for emergencies. The 200,000 yds. of premixed dredged aggregate, furnished by the Kittaning Sales Co., New York, consists of 2 parts clean, sharp sand free from loam, and 4 parts gravel not larger than 1½-in., which are mixed with one part by volume of Portland cement.

The aggregate is delivered from the mixer bin through two Butler batchers that provide for an instantaneous measurement and, operating by levers, eliminating all hand-labor and insuring rapid and accurate service.

The batchers deliver to the charging hoppers of two Koehring 1-yd. mixers, each driven by an electric motor at about 15 r.p.m., thus enabling them to produce standard concrete more rapidly than it can be disposed of.

The output is limited by the maximum speed of hoisting for the distribution system. The bucket makes one trip from the mixer to the top of the tower, and return, and is filled in 45 seconds. The 1-yd. buckets serving each of the two mixers are hoisted by 100-h.p. mine engines to the top of a 240-ft. Insley steel tower that also supports one end of each of two high line cables reaching thence to the tops of the two 115-ft. masts of steel derricks with 10-ton, 100-ft. booms that are mounted on wooden towers 20 ft. high.



MACK 5-YD. POWER DUMPING MOTOR TRUCKS SERVED STEAM SHOVELS WITH ¾-YD. DIPPERS WORKING TO CAPACITY IN PIT 18 FT. DEEP.

The derrick booms support counterweighted revolving trusses in two sections, that carry steel chutes similar to those suspended from the high line cables, both chutes, hoppers and counterweighted trusses being of standard Insley make. The lower ends of the pivoted chutes are supported on movable steel tripods from which short sections of coal chutes, operated by hand, deliver the concrete to any required position in the building area. With both mixers operating, 1,000 yds. of concrete can be placed in one single 8-hr. shift.

The chutes suspended from the high line are enclosed in angle-iron yokes, to the sides of which long, narrow panels of wire netting are attached to prevent the liability of falling from the chutes. Safety hand ropes are also attached to the yokes for the use of the attendants that may, from time to time, have to inspect them or remove obstructions.

The steel derricks are of a special pattern made by the American Hoist & Derrick Co., with straight masts and tapered booms made in sections, field-spliced for convenience of shipment. Both booms and mast have angle-iron latticing flattened at the ends to develop the strength of flanges at the connection. The masts set on 1,370 lb. cast steel foot blocks, affording an extra large bearing surface. About 11 miles of ½ to 1⅛-in. wire rope are installed for rigging and for other purposes.

Special anchorages to resist 90 tons maximum stress are provided for the high-line cables. These consist of timber platforms set in shallow pits and supporting transverse inclined and vertical frames over which the bridles attached to the cables pass to connections with the anchorage timbers. The floors support overhanging boxes in which as much as 2,200 cu. ft. of stone are piled.

The many hundred items of supplies and equipment have been inventoried, printed lists of them provided, and a decimal reference figure given each item to simplify cost-keeping accounting. The comprehensive system has different colored blanks printed for distribution to the different files that are maintained and kept posted to give in multiple up-to-date data by rapid inspection.

PROPOSED SEWAGE PLANT FOR ANDERSON, IND.

By Frederick L. Ray, Supt. of Power Plants, Union Traction Co. of Ind., Anderson, Ind.

The proposed sewage treatment plant for Anderson, Ind., will utilize the activated sludge process. The elements of the Anderson plant are as follows:

The raw sewage after passing through bar screens to remove the larger material, flows through grit chambers where the mineral matter settles out. From the grit chambers the sewage passes to the clarification building where it passes through revolving fine screen drums, the effluent from which is pumped to the aeration tanks. In the bottom of these tanks are a large number of Filtros plates, each one of these is about 1 ft. square and 1½ ins. thick, through which air at 8 to 10 lbs. pressure is forced, so as to produce a continuous stream of air bubbles.

After about six hours contact with the air the sewage is then passed through the activated sludge tank, where after a very short time the sediment is settled to the bottom where it is drawn off and the purified effluent flows out at the top and discharging into a conduit is carried back to the river. In the short time of 6 to 7 hours the raw sewage has been so treated that the effluent returned to the river is as clear and sparkling as spring water and should show an average reduction of 98% bacteria and 97% suspended matter. Sewage will enter the plant and the purified effluent will leave it continuously and the reduction of the sludge to a dry fertilizer will also be a continuous process.

Returning to the clarification building we find that considerable heavy sludge did not pass through the revolving screens. All of this heavy sewage that would not pass through the screen passes on by gravity to the concentrate thickener tanks where the heavy sludge is removed by mechanical means. The clarified effluent from these tanks is returned to the pump suction basin in the clarification building where it is taken up by pumps and sent on to the aeration tanks.

All of the sludge is sent to the fertilizer preparation building where it is dried, screened and ground and where it is made ready for mixing with potash and phosphate to make up a complete fertilizer.

It is estimated that slightly more than

one ton of dry tankage will be obtained from every million gallons of sewage. The plant at Milwaukee with a connected population of 500,000 expects to have 100 tons of tankage daily and Indianapolis with a total connected population of 300,000 expects a yield of 30 to 40 tons, therefore, on the above basis a plant for the City of Anderson should yield from 7 to 10 tons daily.

In this system the "purification is accomplished by oxidation which makes the process odorless and unobjectionable, even when in close proximity to residences and public parks. The system is rapid and flexible in that it adjusts itself to changing conditions."

The cost of the Indianapolis plant was $3,000,000, two-thirds of which was for the disposal plant and one-third for trunk sewers and interceptors. On this basis the disposal plant cost $6.66 per capita and the total cost was merely $10 per capita.

Locating a sewage reduction plant near Moss Island bridge, there would be required a trunk sewer about 0.8 of a mile long and an intercepting sewer along the edge of White River to the eastern boundary of the city about 3.4 miles long. Using Indianapolis cost as the base for estimating the cost for Anderson we would have, with a population of 35,000 a cost for the complete system of $8.00 per capita or a total cost of $280,000. The Anderson plant should cost less per capita than the Indianapolis plant as our present excellent municipal plant could supply all the power needed at the sewage reduction plant. All that the sewage reduction plant would need would be a heating plant in combination with a power distribution station.

If we overlook all other features of sanitation in connection with the proposed reduction plant we must at least recognize the fact that our million dollar, 98-in. sewer, discharges into White River just opposite our new Municipal Golf Grounds. If one will visit this point on the river at this time, one will see and realize a condition of filth that no city should be responsible for. The time is at hand for the City of Anderson to do some more sanitary engineering and construction.

There should be no increase in taxes for the building of such a sewage reduction plant as the cost could be easily paid for out of the earnings of the Municipal Light Plant. Its operation and maintenance will cost something of course, but all cost, made necessary, because of securing more healthful conditions of living, should be willingly and cheerfully borne by all good citizens.

FEDERAL COURT HOLDS WILLITE PATENT INVALID

(Editor's Note: Following is the full text of the opinion rendered by Judge Faris in the District Court of the United States in and for the Eastern Division of the Eastern Judicial District of Missouri, at St. Louis, Mo., on July 3, 1925, holding the Willite patent invalid. The case, No. 6745, was between plaintiffs Western Willite Co., Missouri Willite Co., American Willite Co. and Western Willite Road Construction Co., and defendants, Trinidad Asphalt Mfg. Co., Shelby L. Heman, John C. Heman and the City of St. Louis.)

Memorandum of Oral Opinion of the Court

This is an action for an injunction and an accounting, for alleged infringement of a certain patent, or patents, issued to Harry P. Willis, on divers dates.

The patents pleaded by plaintiffs are No. 1,190,615, issued to Harry P. Willis on the eleventh day of July, 1916; who assigned same to the territorial licensee of plaintiffs; No. 1,328,310, issued to Harry P. Willis, on the twentieth day of January, 1920, who, likewise, assigned same to the territorial licensee of plaintiffs, as also, an alleged infringement of a trade-mark, consisting of the word "Willite" in Gothic letters.

The first two of the patents mentioned were mechanical patents, so called, whereby a new material, as it is alleged, was produced. While not strictly mechanical patents, I so designate them, in order to distinguish them from process patents, which, clearly, they are not.

Great difficulty is met in the case at the outset, by the fact that infringement of both of these mechanical patents, and of the registered trade-mark, is pleaded in a single count of the petition; or, at least, seem to be so pleaded. I am frank to say that I am unable to vouch for the accuracy of this statement. There was, however, in my opinion, no sufficient evidence as to the infringement of the trade-mark, so I think the finding of the Court should be, as to it, for the defendants, on the above ground.

The whole of the evidence, on both

sides, had to do with the question of the infringement of Patent No. 1,190,615, all of the claims of which seem to be in issue here. So, since the evidence adduced, pro and con, lost sight of Patent No. 1,328,310. I am of the opinion that the finding as to it, also, should be for defendants, if, in fact, it is involved here, which I am unable, as said, to determine.

As to Patent No. 1,190,615, the defenses were the usual and conventional ones:

(1) Lack of validity (a) on account of anticipation by the prior art, and (b) lack of utility and, therefore, invalid and not patentable, because not useful;

(2) Lack of infringement.

Claims 5 and 6 may be taken as types. Claim 5 reads thus:

"A plastic composition comprising a finely-divided filler, a mineral asphaltic binder, and sulphate of copper; all of the ingredients being intimately mixed in a highly heated condition."

Claim 6 reads as follows:

"A plastic composition comprising a finely-divided filler, a mineral asphaltic binder, and sulphate of copper; all of the ingredients being intimately mixed and the mixture being so dense as to be practically free from air."

In the specifications, however, I find this set out as a matter of inducement, to-wit:

"The composition comprises a finely-divided filler composed of any soil, earth matter or mixture thereof, a mineral asphaltic binder and a salt having the tempering or hardening characteristics of sulphate of copper when combined with the other ingredients of the composition.

An important advantage of the invention is in the use of a filler which can be very easily and cheaply obtained, as I contemplate the use of any soil found at the place where the composition is to be made and used, or such material and sand, disintegrated stone, clay or similar material as may be obtainable at or near the place where the pavement or other structure is to be placed. In the case of a road being converted into a pavement the old road-bed may form all or a large part of the filler. This filler is finely-divided to a degree such as to facilitate its incorporation with the binder but not necessarily to the degree of pulverization."

From this it is too obvious for argument, that a finely-divided filler is one of the necessary elements, or aggregates, of this patent. Such a filler was not used by defendants in their foundation course, but it was used on the wearing surface of the pavements laid by defendants, on Pendleton Avenue, in the city of St. Louis.

Since the patent is not a process patent, but falls into the category of a mechanical patent, I am of the view that defendants, if the patent is valid, infringed as to the pavement having a so-called "Willite" wearing surface, and that I need not, for the reason just mentioned, consider the pavement as a whole, and so I think I am not compelled to find that defendants infringed as to the whole pavement laid and made by them. In fact, in view of the proven facts that defendant City specified "Willite" pavement, and contracted with its co-defendants for "Willite" pavement, and that defendants other than the City agreed to lay "Willite" pavement, it can hardly be denied that there was an infringement in this case; at least, so far as concerns the wearing surface.

In the light of the views I hold upon the case, I think I need not pass on the question of utility.

Upon the question of validity on the point of anticipation, the case is an exceedingly close and difficult one. Regardless of the pleaded and proven prior art, it is known of all men (and, therefore, I may judicially notice it) that mineral asphalt, whether existing in nature, as in the case of Bermuda asphalt, or Trinidad asphalt, or as a derivative distillate of petroleum, has long been used as a binder in pavements. So, also, has a finely-divided filler long been used as part of the aggregate in the making of pavements. Also, these two components, with others, have long been used in the presence of high temperatures.

The prior patents offered showed the use, also, of divers metallic salts, sulphides, oxides and carbonates, including the sulphate of iron, and the sulphate of copper, which Willis used in the patent in controversy. As to such use, the pertinent patents offered showed, as to the use of such salts, oxides and carbonates as a hardener, in connection with rocky or earthy filler aggregates, and either vegetable or mineral asphalts as a binder component, in brief, thus:

Davis, No. 58,718, used sulphate of iron, gas-tar, calcium, gypsum, and other substances and aggregates.

Pinner, No. 83.539, used asphalt and sulphur, with other things not pertinent.

Ranney, No. 98,522, used asphalt and

bichromate of potash, with other things, and mineral aggregates.

Matthews, No. 114,172, practically the same as Ranney; with stone and gravel.

Saunders, No. 119,476, used bluestone, which is copper sulphate; rosin, pitch, gas-tar, chalk, sulphur, sand and gravel.

Doty, No. 168,559, used sand, plaster, rosin, and sulphate of iron. He also heated these substances with others, and mixed them thoroughly, with certain rocky or earthy aggregates.

Filbert, No. 188,614, used broken stone or gravel, asphalt, sulphur, fine sand or stone-dust, heated.

Lee, No. 188,645, used gravel, pulverized stone, fine sand, plaster of paris, and black oxide of manganese.

McCoy, No. 275,507, used copperas or bluestone, rosin, waste-oil, or residium oil.

Ketcham, No. 10,414, Reissue Patent, used asphalt, alum, sulphate of iron, and lime.

Murdock, No. 394,126, used sulphur and comminuted mineral substances and asphalt, heated to 450 degrees Fahrenheit; cement, stone-dust and sulphate of calcium.

Chase, No. 760,183, used copper sulphate as a hardener; a binder, such as rosin, with pebbles or broken stone, sand, and cement as a filler, mixed, with heat at about 210 degrees Fahrenheit.

From an examination of the several patents mentioned, it will be noted that I have in some instances, and as to some of the patents, omitted some of the constituents; that is to say, I have in some cases only recited the substances which seem to be either identical, or bear an analogy to the substance used in the patent in controversy.

It will be noted that Chase, No. 760,183, used copper sulphate to harden rosin in his patented compound. Rosin may be loosely called a vegetable asphalt, whose use in a pavement, I may well assume, is precluded by cost.

Saunders, No. 119,476, used bluestone, which is a well-known name for copper sulphate, together with rosin, pitch, gas-tar, chalk, sulphur, sand and gravel.

McCoy, No. 275,507, used sulphate of iron, which he calls by its well-known common name, of copperas, with rosin and waste-oil or residuum oils. In his specifications (but not in his claim) he mentions blue vitriol as an alternative for copperas. Blue vitriol is a well-known common name for copper sulphate. However, from the fact that he claims copperas only, and from the punctuation, a strong inference arises that McCoy believed that blue vitriol was but another name for sulphate of iron, thus confusing blue vitriol (which is sulphate of copper) with green vitriol, which is copperas, or sulphate of iron. But it may be well questioned whether such a doubt, even if well-founded, at all helps the patent here in controversy. If the use of copper sulphate was suggested to Willis by an error in a prior patent, invention might well be destroyed.

Much testimony was offered, *pro* and *con*, as to the effect produced by adding copper sulphate to mineral asphalt, in the presence of heat and a constant stirring of the aggregate, touching whether the effect brought about in increasing hardness and impenetrability, was due to chemical action or catalytic action. Plaintiffs insisted that the action was catalytic, while defendants, on the contrary, insisted that it is a true chemical reaction. If, in short, the copper sulphate acts as a catalyzer, it produces reactions in the binder, without a change in its own chemical composition; that is, it continues to be copper sulphate in the resulting mass, while, on the other hand, if the effect is a chemical reaction, then the copper sulphate is converted into some other chemical substance and loses its identity in the resulting mass, and ceases to be copper sulphate.

The discussion may be highly valuable as a matter of chemical discussion, but it is difficult to appreciate its legal significance. I am unable to see why, if Willis had actually discovered an important result to accrue from adding copper sulphate to asphalt, it makes any very material difference whether such result arose from definite chemical reaction, or from catalytic action. Both are chemical changes. In one the re-agent copper sulphate not only acts upon the other substances, producing a change or reaction therein, but is itself acted upon, resulting through such action in its own dissolution as copper sulphate; while, in the other case, it acts upon the substances with which it is mingled, and produces chemical reactions in these substances, whereas it, itself, remains unchanged and suffers no chemical dissolution, remaining copper sulphate after performing its office as a catalyzing agent.

The chief thing was the result. The means do not strike me as being very important legally, or at all, except as mere matters of chemical and physical

casuistry. So, I say, I doubt whether this discussion lends any aid to a decision of the case.

The patents offered of the prior art, showed conclusively that it had long been known that the various metallic salts had a hardening effect on asphalts, residuum oils, coal-tar, and so-called gas-tar, as, also, upon so-called mineral asphalts, and a similar effect on the so-called vegetable asphalts.

The prior art shows the use of such metallic salts to increase hardness; to produce a greater resistance to load, and to reduce penetration. Not only were the sulphates of iron, aluminum, and calcium, so used for these purposes, but the sulphides, oxides and carbonates of these metals, and others, were also employed for this purpose. In at least three of the patents offered by defendants, the sulphate of copper was used to obtain this hardening effect in asphaltic bodies, as note Saunders, Chase and McCoy.

Both plaintiffs and defendants agree as to the results brought about by the use of these metallic salts, such as sulphate of iron, of copper, of aluminum, of calcium and of zinc. It is disputed, however, whether the effect of copper sulphate does or does not surpass that of the other metallic salts named. But be this as may be, it is nowhere disputed that the chemical or catalyzing effect of adding sulphate of iron, sulphate of aluminum, sulphate of copper, sulphate of calcium, to asphaltic aggregates, is to largely increase hardness, and resistance to load, and to decrease penetration.

It might be urged that Willis discovered that sulphate of copper did this best and most cheaply, but Saunders, Chase and McCoy, had used sulphate of copper for the purpose desired, long before Willis filed his application.

It also appears that the chemical reactions, if they are such, or the catalytic effect, if this be the fact, are the same in the case of all the metallic sulphates. So, even if Chase, Saunders and McCoy, have never used sulphate of copper, the use of other metallic sulphates would render the patent to Willis invalid, on account of the well-known doctrine of equivalents. (Lehmann vs. Ripley, 3 Fed. (2d) 518; Pittsburgh etc. Company vs. Seaman-Steith, 236 Fed., 756, and 248 Fed., 705; Smith vs. Nichols, 21 Wall., 112; Miller vs. Monarch, 285 Fed., 364; Sloan Filter Company vs. Portland, etc., Company, 139 Fed., 23; National, etc., Company, vs. New England, etc., Company, 153 Fed., 184.)

I may concede that, ordinarily, the reactions and phenomena of chemistry may sometimes dictate a rule as to equivalents, which is at variance to that rule as applied to mere physical or mechanical equivalents, but I am unable to see any reason for applying a different rule in a case wherein the effects produced by one metallic sulphate is in all respects similar to those produced by other metallic sulphates. I think, on the latter finding of fact, there is hardly any ground for dispute, upon this record. Certainly this is true except as to the question of degree, which was sharply disputed. In the light of the prior use of sulphate of copper, as disclosed in the prior art, I need not pass on this mooted question of degree.

I am unable to see any ground for the issuance of this patent, save for that part of the specification which I quoted, touching the use of "any soil found at the place where the composition is to be made." I seriously question the sufficiency of this, in the light of the prior art.

I conclude that the finding should be for defendants, on the ground that plaintiff's Patent No. 1,190,615 is invalid for anticipation (and for the reasons already given, as to the other patents set out in the bill, if they are now in controversy, which I am unable to determine), and that the preliminary injunction heretofore issued in this case should be dissolved, and that plaintiffs' bill should be dismissed, which is accordingly ordered, and a decree my be submitted accordingly.

REINFORCED CONCRETE PAVEMENT PRACTICE

By H. Eltinge Breed, Consulting Highway Engineer, New York, N. Y.

(Editor's Note: The following address by Mr. Breed was presented at the Eleventh Annual Conference on Highway Engineering at the University of Michigan, Ann Arbor, on Feb. 18, 1925.)

More than a decade ago it became apparent to many road builders that the smooth, hard-surfaced, rigid type of pavement would best meet the demands of the bewilderingly increasing traffic upon our roads. We advocated in locations where the cost would be justified, the building of concrete roads. In many cases,

through the years since, these roads have been entirely satisfactory from the standpoint of both engineer and public. But in some cases they have not. Trouble has started, ranging from small cracks to disintegration of the slab. We sought the causes, which were almost as many, superficially, as the failure themselves. Gradually, through search, research and experience, they resolved themselves into a comprehensive fundamental. Meanwhile we had learned considerable about building concrete roads, and realized how important to success was every step in the process, from selection of aggregates to final curing. Not only did we want some safeguard (as much as we could afford) against possible errors of judgment or execution on the work, we wanted even more some remedy for the fundamental cause of the trouble, to which all other causes were only contributing factors. In short, we wanted something to offset the indefinite and indeterminate stresses set up in the green concrete, and continued through the life of the pavement by every change in weather, by every change in temperature from night to day, by every volume change in subgrade, by every pounding vehicle. We went to structural design for our idea, and came away with steel reinforcement.

Anything that tends to promote stress or be of low resistance to it is a source of weakness in the pavement. Most important of these are:

1. Faulty materials.
2. Improper proportioning.
3. Low density.
4. Poor mixing and working.
5. Too much water.
6. Disregard of temperature conditions.
7. Inadequate curing.
8. High porosity permeability and absorption.

Faulty Materials

No structure is stronger than its weakest part. Then both aggregates should be stronger than the cement which binds the mass together in order to insure developing the full strength of the cement. Stone which is hard and durable is dependable; but rock of high absorptive value, or unstable rock, such as the Arenacious shales and Feldspathic sandstones has led to early disintegration of the concrete. Sands, many of which are adequate for masonry mortar construction, have proven so unsatisfactory in concrete work that through the efforts of various research and test agencies most specifications provide for proper control, such as grading, freedom from silt, and organic matter, etc.

Improper Proportioning

Usually the method of proportioning is arbitrary, such as 1-2-3, 1-2-4. The strength of cement and the large amount of properly graded aggregates has caused this method to suffice in mass concrete and concrete protected from the weather, but it is bad for road work. Proportioning by void determinations is likewise unreliable because of the varying void content of the aggregates under differ ent moisture conditions. Proportioning by mechanical analysis gives good results but in more uniform shipments of materials requires laborious checking and readjustment to keep proper control. Proportioning by fineness modulus and proportioning by maximum density tests are two other methods, both of which give good results.

Low Density

Low density comes from improper proportions, entrained air and excess water voids. The greater the density, other things being equal, the stronger the concrete.

Poor Mixing and Working

Poor mixing and working results usually from too much hurry. A full minute of time in the mixer is absolutely essential for each batch, and additional time will give increased strength. The working of the concrete is to exclude air and consolidate the mass.

Too Much Water

Too much water gives low strength, and a highly porous concrete. Uncombined water in excess of the amount required to hydrate the cement leaves voids in the set concrete which are potential sources of trouble.

Disregard of Temperature Conditions

Temperature conditions at time of mixing and laying concrete are important. Concrete mixed at an average temperature of 50 deg. Fahr. is only 82 per cent as strong as the same concrete mixed at an average of 70 deg. Fahr.

Inadequate Curing

The influence of methods of curing is such that as much water as it is possible to get on will benefit the pavement by accelerating chemical action and preventing too rapid drying out.

High Porosity Permeability and Absorption

Resistance to action of water and moisture is dependent on the porosity, permeability and absorptive quality of the por-

osity, permeability and absorptive quality of the concrete and the expansion and contraction of the mass. Dr. Hatt, in his conclusions to a research study on "The Moisture Effect on Concrete," says: "The strength of concrete, like that of wood, varies with its moisture content. While the law relating to moisture content and to strength was not determined throughout various ranges of moisture content, it appears that saturated concrete will have 80 to 85 per cent the strength of dry concrete." This was confirmed in a research project the writer carried out for the Borough of Queens, New York City, on cubes cut from one of their pavements, which gave values wherein wet cubes averaged only 75 per cent of the value of dry cubes. Further confirmation is the work of H. S. Mattimore, Pennsylvania State Highway Department, and G. S. Hutchinson, North Carolina Highway Department. Dr. Hatt further says: "Concrete expands when immersed in water and contracts on drying. The degree of change of length varies with the characteristics of the brand of cement, with the richness of the mix, and with the size of specimen, and with the conditions of exposure. Measurements begun after the initial hardening of the cement show that concrete may expand 0.01 per cent due to the absorption of moisture and may contract 0.06 per cent when exposed to dry air. These changes continue. To these values should be added the changes in length during the initial setting of the cement." "To be durable, concrete structures should be designed for the least favorable conditions. Stresses arising from the effect of temperature and moisture as well as those due to dead and live loads should be considered."

Further characteristics of the relation of heat and moisture to concrete are the thermal coefficient of expansion, the warping effect, and shrinkage from drying.

"Without careful curing," says Dr. Hatt, "concrete masses will undergo excessive surface shrinkage against their rigid cores, thereby favoring surface cracks. Therefore, steel reinforcing should be placed near enough to the surface to withstand these shrinkage strains, and at the same time far enough below the surface to be protected against corrosion."

Dr. Hatt's beliefs about requirements "for concrete structures exposed to the weather" are as follows:

(a) A Portland cement of normal volume constancy and a clean, well graded aggregate.

(b) An impervious concrete of proportions not less than 1:2:4.

(c) A time of mixing of not less than 1 min. and preferably 1½ min. for the production of uniform concrete.

(d) A concrete mixed with a minimum amount of water appropriate to the work at hand.

(e) Careful slicing of this dry concrete against the face of the forms so that the reinforcing steel may not be exposed nor the surface require patching.

(f) Early curing begun just after the initial set and continued for a time, depending on local conditions.

(g) Design of reinforcing steel and contraction or expansion joints to prevent cracking and the entrance of water.

These eight common sources of trouble all operate either to promote stresses or to lower the resistance of the pavement to stresses. Our aim has been in every way to eliminate or correct them as far as we could along the lines the writer has just roughly outlined, and at the same time to give to the pavement additional resistance to stresses. The general tendency has been toward the use of steel as a method of reinforcement. But there have been and are wide differences of opinion about the amount of steel it is economical to use to get best results at least cost, and about the best distribution of the steel throughout the pavement. It is the main purpose of this paper to present some tentative conclusions about these problems drawn from recent experiments and experience.

The Arlington and Columbia Pike Test

Experiments have been made at Arlington, Va., on concrete slabs over wet and dry sub-grade conditions under impact and static load tests. These are some of the conclusions regarding the steel thus far reached and reported by A. T. Goldbeck, chief, Division of Tests, U. S. Bureau of Public Roads:

"Reinforcing steel in concrete slabs, if present in sufficient amount and so placed as to receive tensile stress, adds to the resistance of the slab to impact."

"Reinforcing steel placed longitudinally and transversely in equal percentages is more effective in preventing corner failures than the same amount placed in one direction."

"For a given percentage of steel, small deformed rods closely spaced seem to be more effective than large deformed rods

widely spaced."

"In some of the tests there was evidence that while the presence of the steel did not assist greatly in preventing the formation of the first crack it did prevent the development of the crack and the further failure of the slab."

"The portions of slabs left unharmed have subsequently been tested under static load, both at the corners and along the edges with the following results: The presence of mesh reinforcement as employed in the slabs under consideration does not increase the load-carrying capacity of concrete slabs, but does give rise to a tendency to hold together and resist complete failure after initial or elastic failure has taken place."

Other indications from observations of the Columbia Pike investigations are:

	No. of Slabs	Corner Breaks	No. of Slabs Cracks	Total No. Lineal Ft. Transverse	Longitudinal
Half width reinforced section on soft subgrade	77	2	28	463	0
Half width reinforced section on fair subgrade	36	0	7	149	0
Full section on plain sand subgrade	64	7	45	817	1105

The Columbia Pike investigations have been described in the October, 1924, issue of "Public Roads." Briefly, the road consisted of 32 sections of both plain and reinforced concrete. The variations in the sections consisted of changes in thickness, changes in cross-section design, the use of cinders under some of the sections and the use of various percentages of reinforcing steel.

Careful observations were made of the development of cracking in the sections and subgrade samples were taken from time to time to note the moisture content and also physical characteristics of material under various sections of the road. "That longitudinal steel up to a certain amount does increase the spacing of transverse cracks, and these cracks will open on contraction." "That longitudinal steel above this amount might produce fine transverse cracks, spaced in some cases only a few feet apart." These are Mr. Goldbeck's statements.

Look for a moment at Arlington Tests on slabs reported by L. W. Teller in "Public Roads." All 4 in. plain slabs on wet subgrade were in such condition that they could not be tested for impact. Numbers 230 and 231 were too badly broken to test and 240 and 241 withstood only static load. On the other hand slab numbers 250 to 259 four inches on wet subgrade reinforced with from 0.21 to 0.32 per cent of steel resisted impact pressures from 7,025 lb. to 8,300 lb. on the edge and 7,790 lb. to 10,950 lb. on the corner. A fact to be noted is that the slab with 0.21 per cent of steel gives resistance values to impact as high as that slab having .82 per cent of steel. This holds also in the tests made on 6 in. reinforced slabs on a wet subgrade.

The writer has checked many of these observations by actual service conditions. A case in point is the pavement at Brightwaters, N. Y., built in 1921 of 5 in. plain and reinforced concrete 16 ft. wide, 1-2-3 mix. There are two reinforced sections; one is a divided slab with 45 lb. of mesh per 100 sq. ft. on soft fill over tide marsh of quaky character; the other is 16 ft. full width on sand and sand and clay, part of it filled ground. The joints are 50 to 60 ft. The following is the result of a crack survey:

Here it is evident that the divided slab eliminated all longtitudinal cracking. The plain concrete had 0.25 ft. transverse cracks per lin. ft. of road, while the reinforced had only 0.1 ft. The plain section had 12 corner breaks per mile, while the reinforced section had 2.

The Bates Tests

Section 51 of the Bates Test Highway, Illinois, after destructive tests is still doing fine service in good condition. This is a 6-in. uniform section reinforced with 45 lb. of mesh per 100 sq. ft. and had there been a buffer section between that and a weak sister it would be intact today.

There is no question in my mind but that in the light of all the evidence:

A. Reinforcing steel helps, whether in full or half width work, to resist early stresses at a critical strength period from the first day to the twenty-eighth day, and then acts to help preserve the integrity of the slab.

B. That it reduces materially longitudinal cracks when used in full width work.

C. That when used in proper amounts the slab lengths can be extended to 50 ft. and upwards to 100 ft.

D. That except additional amounts at corners and along the edges, any amount of steel used above that necessary for temperature stresses serves no useful purpose until enough is used to reinforce as a full structure. The cost of such complete reinforcement for highways is

unnecessary and prohibitive.

E. Steel is essential to preserve the integrity of the slab in the first 28 days of the pavement life, for when cement and aggregates are mixed with water, chemical changes begin which convert the plastic mass into a material whose strength in tension and compression increase with age. Evidence of these changes is the hardening or "set" of the concrete, which occurs within 24 hrs. after the mix is laid. Its tensile strength or ability to withstand pulling apart, practically nil on the first day, increases at a varying rate daily, until at the end of 28 days it is 90 percent of the strength it will have in two years. At 3 days it has 34 lb. tensile strength per sq. in.; at 7 days, 61 lb.; at 10 days, 81 lb.; at 14 days, 95 lb., and at 21 days, 109 lb. These figures represent minimum values found in the laboratory. As field values would run even lower, the ones quoted are those on which we must calculate in order to secure a reasonable margin of safety.

Compressive strengths for 1-2-4, or 2,000 lb. of concrete, at 28 days for early ages are as follows:

Days	(1) Compressive Strength Av. Temp. of 68 Deg. Fahr.	(2) Compressive Strength Av. Temp. of 71.2 Deg. Fahr.	(3) Per Cent of 28-Day Strength		(4) Tensile Strength for Col. (1)
3	400	500	30%	600	34
7	720	700	46%	920	61
10	950	800	57%	1140	81
14	1120	1020	70%	1400	95
21	1280	1240	82%	1640	109
28	1350	1400	100%	2000	114

Col. (1), (2), (3), from A. B. McDaniel, on Effect of Temperature on Concrete, Proceeding American Concrete Institute 1916, pages 245, 248, 259 and 260.

Col. (4) computed by taking 8½ per cent of the values given in Col. (1), Johnson's "Materials of Construction," page 419, on relation of tensile to compressive strength. The above values though appearing low are not exceptions and are confirmed by many investigators.

But the changes in the drying out of concrete during the increase of its tensile strength, set up also the destructive stresses. These are due to expansion and contraction. As the moisture is evaporated from concrete, its bulk thereby diminishes, and the mass contracts. In general, the tendency is to shorten its length. The pull comes between different sections of the mass. If, on the other hand, due to different conditions, expansion occurs, you have first push and then pull. If the resistance can be fostered to withstand this pull, the pavement holds its integrity. If it cannot, the sections yield to the pull and separate, leaving cracks between them which subsequently widen. It is these cracks, which, requiring maintenance, menace the life of the pavement by multiplying the places of weak resistance to impact. Devices have been tried to substitute moisture to replace that evaporated and so give the concrete a chance to establish some strength before meeting severe stresses, but none of these, wet burlap sprinkling or straw or earth covering, has been wholly satisfactory, though they have helped. The difficulty is that the moisture cannot be supplied to the pavement as fast as it is evaporated, or at the same uniform rate; also, when the pavement is sprinkled, some of the water is bound to run off to the edge of the pavement, where it causes volume changes and sets up other stresses.

The problem is then to increase the resistance of the concrete to tensile stresses at a time when those stresses are strongest and the concrete itself is weakest to withstand them. The only way we now know to do this is through the use of reinforcing steel. The steel fabric with its welds has its full strength when it goes into the wet slab. Used in proper quantities, that strength is sufficient to preserve the integrity of the concrete slab against the opening up of any cracks that form.

Other factors of design are generally agreed upon.

The thickened edge and balanced design (i. e., strength in the center of the slab equal to 7/10 of the thickened edge) are approved by Mr. Older, Mr. Goldbeck and general service conditions.

The tongue and groove longitudinal joint transfers the load across the joint to the other slab, as is shown in the deformations on the Harrisburgh Test Road, which indicate that one-third or more of the load is transferred.

Other principles of design generally accepted in theory and used in construction are:

The use of dowels across both transverse and longitudinal joints to transfer the load.

Theuse of the design formula recommended by Mr. Older, and since adopted in the Association of State Highway Officials' Specifications and American Society for Municipal Improvements tentative specification for concrete pavements.

The use of a waterproof joint material. This can be secured by a poured asphalt mastic joint material.

The use of additional reinforcement along the center joint and the edge of the pavement.

In regard to maintenance, direct comparisons between reinforced concrete and other types of pavement are difficult to obtain. Figures of the cost of maintenance for the state of Ohio for the year 1922 for 4,700,000 sq. yd. of plain concrete roads show a cost of $0.0223 cents per sq. yd. for maintenance, while for 2,900,000 sq. yd. of reinforced concrete pavement (light mesh or circumferential reinforcement), the cost of maintenance was $0.0043 cents for sq. yd., or only one-fifth of the cost of maintaining the plain concrete pavement. This relation is approximated in the work in New York state, and in my experience with my own work.

My conclusion is that with reasonable first cost and negligible maintenance we can, safeguarding the eight common sources of trouble in concrete pavements, reinforce the carefully built pavement with steel, and we can thereby get a result that will bear whatever traffic may legitimately be put upon it.

HIGHWAY LIGHTING

By R. K. Malcolmson, Engineer, Public Service Co. of Northern Illinois, Chicago, Ill.

(From an address before Western Society of Engineers, Chicago.)

Most of us have foresight enough to see that a new type of street lighting is rapidly becoming necessary and that is highway lighting, especially on the highways immediately outside of the larger cities, and connecting suburban towns.

Traffic out of larger cities to adjoining suburban towns, and also all traffic between adjacent large cities is so congesting the highways in the daytime that the only feasible solution to relieve traffic congestion is to get the bulk of that freight and cartage traffic moved during the night. Take, for instance, the truck deliveries from the large department stores to the suburban towns and the intercity truck deliveries—if we can concentrate the movement of that traffic in the period between midnight and dawn, when the roads and highways are not so much in use, it will have a tendency to relieve congestion in the daytime.

A survey made in New York showed that traffic delays in New York City caused the living expenses to be about a third higher than in the surrounding towns—that traffic delay, of course, was accounted for in the added cost of delivery and other economic expenses.

Only last week the Chicago Tribune carried an article about one of the large department stores in New York considering the delivery of all goods within the city by horse-drawn vehicles and doing away with motor trucks, because the motor truck standing idle so long in traffic delays made it a poor investment from the point of view of the retail store.

Something must be done to relieve traffic congestion. One plan is to increase all of our highways to a width of 24 ft. and even wider, so as to relieve the city streets as much as possible of any unnecessary truck deliveries during the day. Night traffic is becoming of especial importance on the highways on account of the rapid growth of the suburban communities. On the principal highways leading out from Chicago on week ends due to extreme traffic congestion, one can probably walk along them as fast as he can ride over them.

The first lighting plan for highways should include all highways leading directly out of Chicago, to the suburban towns, and then others as the comparison of expenses of highway lighting and the resultant benefits have shown the lighting to be worthy of additional appropriation. State highway lighting should be extended throughout the state on all of the highways, and finally throughout the country, so that all of the principal roads will be lighted. Of course, we cannot hope for that at once.

Distribution Problems

This problem of highway lighting means that we have to give some attention to electric distribution for lighting units along the highways. It is different from the city streets, in that the ordinary residence lighting is mainly a protective lighting; then of course we also have our white way ornamental post lighting, which is advertising lighting as well as protective lighting, but highway lighting is an economic necessity as well as ordinary protective lighting for traffic. Illumination on the highways should be uniform, and of high enough intensity to provide a clear vision for the driver at least 100 ft. in front of the vehicle. Economy of installation cost will determine how close together the units can be placed. The ideal placing or spacing of the units would be approximately ten times the mounting height, but this some-

times might be too expensive, so that the best spacing will be one that will be within the financial bounds of the lighting appropriation available.

The state highways are well protected by laws regarding the distance of pole lines from the center of the highway. I think the average distance from the edge of the highway to any pole or sign that can be constructed along the state highway is about nine feet. The chief trouble and inconvenience on highways at night, is the glare resulting from opposing automobile headlights. If any adequate provision is to be made for proper highway lighting, the light must be placed high enough so that it will be out of the normal range of vision and to provide even, uniform illumination so that there will be no blinding or spotty lighting effect.

The ideal spacing is about ten times the mounting height of the lighting unit. The lighting unit should be approximately thirty feet from the ground, so that a spacing of ten times the mounting height would give a distance of about 300 feet between successive units. If a pole line for electric suburban and rural service is already established along a highway, the units will have to be spaced according to the spacing of the pole line. Pole lines on most of the Chicago highways have an average spacing of 125 feet. If a light is placed at every third pole, we would have an average spacing of 375 feet. That might not be ten times the mounting height, but it might be the closest approximation that can be obtained. In Indiana on the Lincoln Highway an ideal lighting installation was made with the lighting units installed on concrete poles, and of course there the spacing could be determined to suit the requirements.

Investment Necessary

Unfortunately, pole lines for installing highway lighting are not always available. Away from the larger cities, the rural line extensions of the public servicing companies to outlying towns are used. That means that the lights, if they are to be placed on the existing pole lines, ordinarily will be on pole lines that are too low to permit a thirty foot mounting height. As practically all of the pole lines along state highways carry high tension service, it is na very good practice to try to locate a lighting unit above the high tension line, so that, although from an ideal point of view a 35-foot mounting height should be used, sometimes it is rather impractical on account o fthe presence of other wires or other service on the pole line.

That brings up a question as to whether highway lighting should be kept distinct and apart from the distribution pole line of the public servicing companies.

This presents the question of investment needed for the highway lighting including the additional poles, the distribution wires and the fixtures. In the Chicago territory there are three possible ways of having highway lighting financed, either directly financed by the state, by the township, or the villages through which the highway passes. It is a pretty hard thing to say who should finance highway lighting. It is a thing that will have to be worked out and worked out very soon on account of the increasing daytime congestion on city streets, the added night traffic, and the especially heavy night traffic that should be on the highways if they were properly lighted.

Requirements

A successful highway lighting unit should have the following properties: It should be able to use a fairly small lamp, such as 250 candlepower, or possibly 400 candlepower and yet throw a high intensity of illumination on the roadway. That means that no light can be wasted in the fields, no night can be wasted upwards and no light can be wasted either on the side of the road or directly underneath the unit. The light source should be removed from the line of vision, so there will be no blinding effect, and the unit should provide uniform illumination over the entire highway. Of course this will be determined largely by the spacing of the units. Practically every one of the highway units now on the market does these things either by the use of glass refractors or by refractors and reflectors combined, and in the case of one unit, by the use of a highly polished parabolic reflector.

A discussion of the design of lighting units could require a whole evening so I will not enter into that now. What I want to bring up here is the feasibility of highway lighting, and its importance; especially now, with the congested conditions of our streets and highways.

Another important factor in a highway lighting unit is the maintenance, the lamp renewals and the cleaning of the unit. A unit placed 35 feet in the air is sometimes rather hard to reach to replace lamps, and from the point of view of an operating company I think that is

sometimes under-estimated by some advocates of highway lighting. To have a man climb up a pole to a height of 35 feet and unscrew a lamp, clean it and screw it back in again, clean the reflectors, etc., takes a lot of time. The unit should be designed so as to make that work as easy as possible.

Adds Small Cost

The necessary expenditures for highway lighting are very small compared to the cost of an 18-foot concrete pavement. According to the records of the highway department, I believe the concrete pavement in Cook County costs between $35,000 and $40,000 a mile, that is, an 18-foot pavement. For $2,500 additional cost per mile a very good system of highway lighting could be installed. That would make the highway useful 24 hours of the day. That is less than ten per cent of the cost of building the highway, and it certainly should be worthy and should be valuable enough to be justified on account of preventing accidents, eliminating the glare from auto headlights and adding to the comfort of the night driver. It would decrease the running time of trucks and pleasure cars between the larger cities and the suburban cities. It would increase real estate values by tending to bring the growth of the city along those lighted highways. And from the operating standpoint of the utility company, it would bring electricity to rural communities, to farmers and to smaller settlements that wouldn't have this service if there hadn't been a pole line. Probably any highway lighting that is installed in the next few years will be in connection with the distribution lines of a utility company, on account of the expense.

Granting that highway lighting has passed the experimental stage, because in the East it has been worked out very successfully, some means must be provided to finance it and make it an established fact. Some steps must be taken, either to get a bill through the legislature to make an equitable division of expenditures among the different parts of the state—the state might bear a part of the expense or the township or the village, but each one of these political divisions must make up its share of the expense.

WHY THE MOTOR TRUCK IS SUCCESSFUL AS A RAILROAD ALLY

By G. C. Woodruff, Assistant Freight Traffic Manager, New York Central Railroad, New York, N. Y.

During the past few years so much has been said and written of the motor truck as a competitor of the railroads that the subject which today is assigned to me presents an opportunity of discussing the motor truck in another and in my opinion a more correct designation.

The dictionary defines the word "ally," the noun, as, "A person or thing connected with another, usually in some relation of helpfulness in kinship—any friendly associate or helper," and hewing strictly to this definition it is my purpose briefly to recite some of the controlling reasons which have affected and do still affect the degree with which the full meaning of the work is realized in actual practice as between railroads and trucks.

The proper function of a railroad is, broadly, to furnish to the shipping and receiving public the best possible kind of service at reasonable rates consistent with its likewise important and necessary obligation to the investing public in the matter of a return on such investment.

By law such return has been fixed and since its enactment and taking the railroads as a whole, this return has not been earned.

Leaving out of the question for the moment at least, any discussion of rates and their possible increase or decrease, the important problem confronting the railroads is how to realize a larger net income from a given amount of gross. A very easy and theoretically simple solution would be to ascertain the sections or branches of the road failing to show a profit and either cut down the service or eventually cease operation. In actual practice such a situation could hardly obtain, except as a last resort in the case of railroads which as a whole were being operated at a loss.

In all roads not in such an unfortunate situation, quite another means must be employed. Since the return of the roads to private operation and control, there has been indisputable evidence of the ability and desire to render the highest possible service and at the same time handle a peak load of tonnage. The rec-

ords speak for themselves and therefore need no mention in detail here.

Every possible means to the end has been employed—and those best qualified by years of operation experience have been ever on the alert to make use of any plan or series of plans that would in the end produce either better service at the same cost, equal service at decreased cost, or best of all—improved service at decreased cost. Improvements in track, lessened grades, curves eliminated have made possible the operation of heavier power and longer trains. Long engine runs have been tried in many cases most successfully. Fuel conservation and its proper and economical use have been the watch word of the day—heavier tonnage per car has been undertaken and where secured, played its part. The personal side of railroading has been investigated and the pride of occupation encouraged to the utmost degree, for after all by far the largest part of the railroad is "men."

During the same five or six years just past, due in no considerable measure to the large and important part taken by the motor truck in the war, there has come a gradual but nevertheless steadily increasing use of the motor trucks for handling a greatly diversified class of tonnage varying distances.

From small beginnings which might possibly be ignored the total tonnage gradually reached figures that were a subject of real concern and made necessary most careful and far reaching consideration and investigation as to what should and could be done.

There have been those who said, "Oh, let the trucks take the short haul traffic, and we, the railroads, will handle the profitable long haul, heavy tonnage," but experience soon showed the fallacy of such reasoning for while the trucks in many cases did haul the short haul freight, they took only that part of it which was attractive, leaving the railroad burdened with the handling often at a loss of what was left. The experience of the motor trucks themselves, I think, quickly demonstrated that the so-called long haul traffic might well be left to the railroads. To those who may have looked upon the motor trucks as competitors, the natural thing might seem to be to follow the usual course in business practice of absorbing them or putting them out of business. To those who did not hold this viewpoint, such a course seemed both unnecessary and unwise, and experience has demonstrated the correctness of this latter view. The old fable of the sun and the north wind is just as true today, as when written, and so the regarding of the motor truck as a friend and useful ally rather than an enemy and obnoxious competitor, has in the case of certain railroads at least, worked itself out to be a not inconsiderable degree of success. In very briefly reciting some of the more important phases and factors of such an undertaking, I will in so far as possible speak of railroads in general, rather than of any particular road, but obviously neessarily must in detail think of some particular undertaking.

The use of trucks in conjunction with railroad operation is nothing particularly new, except in its present day application and extension as the motor truck became improved and available for more general use. Years ago merchandise or L. C. L. freight was trucked from the smaller to the larger stations at given points, such as New York, in order to build up straight car loading and avoid rehandling at some transfer up the road. Here the question of service was paramount, for with the relatively low operating cost of those times, the difference in expense was not of such great importance as it is today. Let me say, however, that this trucking was performed by horse drawn vehicles long before the commercial motor truck as such was actually a fact. In passing it should be said that today the use of the horse drawn truck vs. the motor truck, be it of gasoline or electric type, is a matter of more than casual importance and there is every evidence that each type has its limitation and therefore its proper field of activity. The handling of merchandise freight from and to the small stations on branch or main line by so-called way-freight has been a never ending source of thought with very little opportunity for improvement with the usual method of handling. Here the freight could not be allowed to drift away to a commercial trucking concern, for no trucking concern operated and in addition with destinations often times far distant, the railroad would ultimately have to handle the most of the mileage.

The thought then naturally came, why not handle by motor truck as a part of the railroad handling for such part of the mileage as would make possible the elimination of the way-freight to the larger terminal.

This has been tried out most successfully and from very small beginnings grown to major importance with satisfactory results from both service and operating cost standpoint. Again in branch lines running nearly parallel to main lines and distant from 5 to 25 miles, under previous methods the freight on the branch has been taken its whole length to the terminal—now it is trucked cross country to the main line larger station and there combined. Most of the larger cities are serviced by more than one railroad and are usually junction points for the interchange of freight originating on one railroad and destined topoints on or via the second railroad. The connecting tracks generally made the interchange a matter of handling around the city on belt lines with many switch movements and much delay and expense. Now in the case of break bulk cars, L. C. L., it is possible and a matter of daily practice to truck direct from one terminal to the other, usually a matter of minutes rather than days. Here again the results from a service standopint are self-evident and the expense in most cases is appreciably less.

There are undertakings to handle freight of all kinds by track to and from steamship piers rather than to lighter under the accepted practice. Trucking from a larger concentration or transfer point to the smaller delivering stations is much more satisfactory than to handle by the former train service. The handling by truck of unit containers for LCL merchandise and CL coarse, or bulk freight has been worked out to a very satisfactory degree and would have been impossible both as to inception and extension without the motor truck.

In the experiments in store door delivery and pick-up service in which certain railroads have already entered—here again the use of motor trucks is of itself necessary.

I have but briefly set down what might be termed the head lines or guide post of motor truck use from a railroad standpoint, not with any idea that the limit had been reached but rather that from these undertakings which have grown from very small beginnings to operations of some magnitude—other and perhaps better uses could and would be found.

The railroads must of necessity regard the motor truck not as a thing *per se* but rather as a means to an end and usable in conjunction with other means of railroad operation only to the extent that it can and does serve some real purpose. From what has been done by the railroads as a whole during the past two years, there is every indication that merely a start has been made and that if properly worked out and co-ordinated the next five years will see continued and increasing use of motor trucks in railroad operation, and this expansion will be, I think determined very largely by what is done by the motor truck manufacturers themselves.

The best evidence of the viewpoint and inclination of the railroads towards motor trucks is the record of the past two or more years and the further fact that in the face of discouraging, and if I may use the term illegitimate and ill-advised competition, by its very increase in use the railroads themselves rather than the motor truck manufacturers or operators have proven the case for the motor trucks. It may be argued that the railroads were only doing so for their own selfish purpose and no love or consideration of the motor truck as such. With such a statement it would serve no purpose to disagree, for here again the record speak for themselves and if so much can be accomplished in such a short time and the use of motor trucks so increased, it would seem reasonable to assume that with a little more of encouragement from the motor truck side, the railroads would find it possible to make still wider use of the trucks.

Considered as allies, and this I believe they are in the truest sense of the word to be a friendly associate and a helper, there must be certain things done or refrained from being done by the motor trucks, if they would bring the best results to the railroads and in so doing to themselves.

Here there are many differences, for the motor truck is a free lance and can go and come at will, charge what it can get, and take or leave it as it may desire in a particular day.

The railroad on the contrary must do just the opposite, for its rates are fixed by tariff and must be published and cannot be changed at will—it must operate rain or shine, winter and summer—it must take all that it is offered for shipment. I cannot but feel firmly convinced that all those motor truck manufacturers or operators, who have the real best interest of the truck development at heart, will agree without reservation that the sooner such a situation is corrected by

placing motor truck operation under some authority, be it state or interstate, or both, and placing upon such truck operation duties and obligations as common carriers fairly comparable to those under which the railroads function that it will be for the ultimate betterment of the truck industry, even though for a time the contrary may seem the case.

When the motor truck manufacturers can bring about a control of sales so that additional motor trucks will go only where there is real need for them rather than by encouragement of sales whether there are already more than enough to handle at fair rates the available business and when through a specialized and properly developed system of credit, a bona fide trucking concern having railroad contract, may be assisted and encouraged to purchase the proper equipment for the particular purpose so as to do it most efficiently and economically, when the matter of taxation and road costs are settled in a fair and equitable manner, as they must of necessity be settled, then the motor trucks as an ally of the railroads will assume a degree of importance many times greater than can be possible otherwise. No one, I venture, would be rash enough to predict the millenium in the use of motor trucks or anything else in the immediate future but by a process of evolution and the gradual ironing out of the hindrances, a long step will be taken along the road.

In this brief time I could but touch on some of the outstanding points by which the motor truck and the railroad can be allies in the truest sense of the word—each helping the other to do the thing in hand in the best possible way.

There is so much encouragement in what has been done that I can see nothing but increased encouragement for the future, for the railroads must of necessity be prompt in making use of any improved form of transportation.

Many of the motor truck concerns are today through specialized departments seeking to work out the proper use of motor trucks along broad lines and particularly with reference to their use for railroad purposes. Such undertakings can only realize the proper measure of benefit if there is full co-ordination and support by the sales and credit organizations, so that immediate individual results will be subordinated.

In this age of marvelous development and progress along all lines, nothing is impossible and the dreams of today are the realized facts of the future. In the record of progress, transportation has had and must of necessity continue to have a large part. Man packs—dog trains, sleds, boats, ox carts, horse drawn and motor vehicles, electric and steam railroads and airplane, all are means to an end—namely, transportation. There may be difference of viewpoint and opinion as to the proper place of each, but as water seeks and finds its own level, so ultimately the proper field of activity is found.

As in the great war it took some time for the Allies to function properly and there were many questions of method and procedure that had to be settled—similarly there has been a like condition with the allies—the motor truck and railroads but by a spirit of mutual understanding; a desire to appreciate the problems of each other; a purpose to rise above any individual advantage; differences are slowly but nevertheless surely being ironed out so that the railroads can and no doubt will make increasing use of this important agency of transportation.

The foregoing address by Mr. Woodruff was delivered at the Mid-West Motor Transport Conference, held in Chicago in May.

WHY IS A CITY?

By J. A. Van Osdol, General Counsel, Union Traction Co. of Indiana, Anderson, Ind.

(Editor's Note: The following address by Mr. Van Osdol was delivered at the latest annual meeting of the Indiana Municipal League).

Municipalities are as old as society, and so are many of their problems. The municipalities with which we are most familiar are the county, the township, the town, and the city, all of which have a common origin—they are creatures of the state. The city is the type of municipality selected for consideration in this paper, and in calling attention to some of the problems that confront the city of today, it is my belief that most of them spring from a lack of understanding of the true place the city occupies in our scheme of government.

A proper understanding of the limitations of the city's powers, is necessary to an intelligent solution of any of these problems. It is fundamental with a self governed people, that within the organic law on which their government rests, cer-

tain restrictions, not only upon the individual, but upon that agency which they create and call government, and upon every sub-division of it, are absolutely necessary.

A better understanding of the limitations upon a municipality as a unit of government, may be had by considering what a city is, and why it is.

We can imagine that in ancient times people congregated in cities largely for protection. As these centers developed and became organized, and were able more and more to furnish to the inhabitants not only protection, but a certain measure of service which the one dwelling outside could not have, and as this feature of urban life expanded, we see mankind seeking the city for the service which it can render him, and the city of the present day becomes attractive for that reason, and service is the answer to the query which the subject of this paper suggests.

A city has been defined as an agency created by the sovereign, for the purpose of carrying out in detail, the object of government. In earlier days the king would grant to some person, or to some group of persons, the right to form a municipality. This grant, sometimes referred to as a royal charter, conferred upon the grantees, or upon the municipality to be formed, certain powers of government, whether liberal or otherwise, probably dependent upon the temper of the monarch at the time the charter was granted. The municipality thus created had just such powers as the sovereign saw fit to confer upon it, and no more.

In several respects you will note a similarity between the municipality of the ancient and that of the modern day. In our scheme of government, the state is the sovereign and the city is one of its sub-divisions, upon which the state has conferred certain specific powers. In other words, the state creates the city as an agency for the purpose of enabling it to administer within a given locality the laws of the state.

Our own Supreme Court has defined a city as a "sub-division of the state, created for the purpose of local self government." Self government as referred to in that definition, means the right to self administer through local instrumentalities, the laws of the state, or such local laws as the state has given the city the right to adopt and promulgate for local purposes, all of which must be in harmony with the general principles laid down in the constitution. Thus, we see the city, a mere agency of the state, possessing only such powers as have been expressly granted. It follows therefore, that all powers not thus conferred, remain in the state.

An Agency of the State

As an agency, created for the purpose of administering locally the laws of the state, the city is more than a mere convenience, it is a necessity. Imagine, if you can, the state trying to administer directly to all of the people of the state, with all their varying interests and local needs. Merely suggesting it, shows how impossible it would be of accomplishment.

City problems vary with local conditions, and, as a rule, increase in number and complexity as the city grows in population. So that the charter which would be sufficient for the City of Anderson, would be a misfit for Indianapolis. To meet this situation, the state has wisely provided special charters for cities of a given size, all of which conform in principle to the organic law of the state, differing only in the procedure and instrumentalities for applying those laws.

In viewing the city as an agency of the state, it is well to note that there are certain powers of government of which the state can not completely divest itself. To illustrate: The state should not so completely surrender to the city, the power of taxation, as to result in crippling the revenue of the state. The state can not afford to surrender entirely to the city, its control over elections, especially when state officers are to be chosen. The state can not afford to so completely divest itself of its police power, that it could not enforce the criminal laws of the state, the health laws, or laws guarding public safety and public morals. The borrowing power of the city should be carefully restricted by the state. The state must retain a sufficient measure of control over education as to enforce certain standards in its public schools. In general, the state must keep such a grasp upon all of its parts—counties, townships, towns, and cities, as will prevent a part from operating against the whole.

There are powers which the state may permit its agency to exercise, but of which the state may repossess itself whenever the general welfare makes it necessary.

The Police Power

One of the attributes of sovereignty of which the state can not divest itself, if it would, is that of providing for the general welfare. The power by which it does this is known as the police power. That power has been defined by our own Supreme Court as "the power of each state to regulate the relative rights and duties of all persons, individual or corporate, within its jurisdiction, for the public convenience and the public good."

In another case, our court, in speaking of this power, said: "The police power springs from the fundamental principle that every property owner must so use his own as not to endanger the safety, health and general welfare of the community."

The great and ever increasing ability of the city to provide service for its inhabitants, is so attractive that the old time drift to the cities has been so accelerated as to cause much concern. That problem, however, is not exclusively the city's. It is presented to society in general, and is viewed with deep concern by those who see in it a tendency to build up the city at the expense of the rural community, thereby disturbing that balance in our social and economic life, which has long been pointed to as one of the secrets of our great national development. However, all agree that the solution of this problem does not involve making the city less attractive or less serviceable, but rather how to make rural life more so.

In the rapid development and extension of our utilities is seen a possible aid in restoring the desired equilibrium. Those utilities, which for years have served to make city life more and more attractive, in comparison with rural life, are now rapidly reaching the point where their service is being extended with the utmost efficiency throughout the rural community, thus making rural life more comfortable and more attractive. In this electrical development leads. So it may be that the very things that have helped to disturb the balance between the urban and rural communities, will become influential factors in restoring it.

Transportation

Not the least in importance of all the agencies in the working out of this problem, is that of transportation. Next to water and light, transportation may be named among those conveniences most necessary to the orderly development of the city. The field long occupied by the street railway is now being invaded by the automobile, more especially the jitney.

There is in almost every city, a certain amount of useful service which the so-called jitney can render, and its operation as a utility should be regulated with that in view. To permit a jitney service to establish itself along routes already served by the street railway, and divide the traffic, when the whole of it is scarcely sufficient to pay the operating expense of the latter, is a wasteful duplication of utility service and an injustice to the railway that has not only been required to make large capital investment in its plant, but is required to expend annually, large sums in maintaining it, and in repair and maintenance of the portion of the street occupied by its tracks.

Aside from the jitney, the automobile has, within the last few years, brought to the front a problem in city government exceedingly difficult of solution, that of traffic regulation on city streets. When our streets were first laid out, this class of traffic was not even dreamed of, and streets that were then ample, are today wholly inadequate to carry with safety the traffic that is imposed upon them, and traffic regulation has suddenly become a problem of first importance. In many cases it is impossible to widen streets, except at a cost that would make that step next to impossible; in other cases this seems to be comparatively simple.

This increase of the automobile, and the speed with which it traverses our streets, emphasizes the importance of planning now for the future. Ample, through thoroughfares must be provided, certain streets must be designated for one-way traffic only; in all extensions of existing streets, and in the laying out of new ones, and in the platting of new additions, due regard must be had for traffic needs of the future.

The problem is becoming very acute in some of our cities, where the business center is supplied with comparatively narrow streets and with rapidly growing automobile traffic. Consider, if you please, that in the last four years and eight months, pleasure automobiles in Indiana have increased 84 per cent, and then imagine, if you can, the nature of the problem at the end of the next five years, unless you plan for it now.

Planning and Zoning

This view emphasizes the importance of careful planning and zoning, and those cities which have taken advantage of the present law in that respect, may regard themselves as fortunate.

Planning and zoning is new and little understood by the general public, and for that reason is likely to be unpopular until results are more fully achieved and better understood. City planning is not to be confused with city beautification. It is more than that. The primary purpose of planning is to make the city more serviceable. If properly done, beautification will come as one of the by-products.

Zoning is likely to be unpopular, especially with the one who imagines that he should always be allowed to do what he pleases with his own. The man who feels that he has a right to erect on his own lot a butcher shop or a blacksmith shop, sees in zoning an interference with his personal liberty, when his neighbor, who owns the lot immediately adjacent, has already erected on it, his residence, and objects to the presence of the shop. Zoning protects the man with the residence, by saying to the other, you must put up your shop in one of the localities set apart for that purpose. The man who would put up that shop at the expense of his neighbor, probably was unable to appreciate the duty he was under in the first instance, to use his own property in such a way as not to unnecessarily interfere with the rights of his neighbor. Very often that man fails to appreciate it, even when the law points it out to him and requires its observance.

Every man who takes up his abode in the city which affords him opportunities for better educational, religious and social advantages, its utilities service, its police and fire protection, impliedly agrees that in exchange for these privileges, he will be willing to forego personal privileges which he would be free to exercise if living in a rural community.

Good citizenship requires us to understand and obey the rule fundamental in our scheme of government, that the rights of the individual must yield to the rights of the community. In other words, the general welfare is of first consideration.

Utility Regulation

The right, in fact, the duty of the state to intervene in matters which concern the general welfare, is well illustrated in its supervision of public utilities which were once merely matters of local concern, but which have grown and developed and extended their activities until they vitally affect the people at large. The state, in exercise of its duty to provide for the general welfare, found it necessary to take control of certain designated utilities so far as their activities concerned the public at large, such as rates and service. This has been done by practically all the states through an agency like that in this state, the Public Service Commission.

The enactment of that law, was necessary to correct evils of the most serious sort which had grown up in many localities, where the utilities were wholly under the control of the local government. In doing this, the state merely repossessed itself of a power which it had always had.

While the purpose of the Public Service Commission act aimed at the maximum of service at the minimum of cost, and to prevent unfair and unjust discrimination, many cities and many citizens, who believed such a law necessary, became dissatisfied with its application. Whenever the law was so applied as to reduce the rate for a given public service, it was popular with the public in that locality, and by the same token, when it was applied to increase a utility rate, it was unpopular. Some persons could see no purpose in the law except that of reducing utility rates. That there could be any justification for increasing a rate, was not by them accepted as possible. In brief, there were a great many who appeared to take the position that a utility had no rights which the law was bound to respect.

The most that the public ever heard regarding rate regulation by the Commission, was when rates had been increased, and there are many today who would be surprised to know that within the last three years, the number of cases where utility rates have been reduced, probably equals in number those where rates have been raised by the Commission.

That the Commission may make mistakes in administering the law, and the courts make mistakes in interpreting and enforcing it, is conceded, and while it is the privilege of the American citizen to criticise these failures, we should be careful to direct our criticism against the real faults and not appear to condemn the law, when possibly the law is all right, or to condemn the courts as an

institution, merely because some judge has made a mistake. Often, when we feel like criticising, we might find that the Commission or the court was right, if we knew more about the facts upon which that decision rests.

Rate regulation is a fruitful field for complaint and sometimes unjust criticism that leads to an erroneous view of the law.

It has frequently occurred that when some rate which had been previously fixed in a franchise which the utility had acquired from the city under vastly different economic conditions, and it was later found that if the utility was to live and continue to render service in that community, it must have a higher rate than that fixed in the franchise, there naturally arose these questions: By what right can the state do this? In doing so, does it not violate the constitutional guarantee against the impairment of contract? The answer to these questions is found in the duty of the state, which one of the higher courts of the land has defined in this language, "The right to regulate rates is a matter of general concern and does not pertain solely to local munipical affairs," and in the general principle which guarantees to the corporation or utility the same measure of impartial justice that it guarantees to an individual.

The limitation upon a city dealing with a utility, especially with reference to rates and service, and the control which abides in the state, is well expressed by the Supreme Court of Missouri, in a recent case refusing to recognize as binding on the state, conditions fixed in a franchise which the court regarded as incompatible with the public welfare. On that point the court said:

"Neither the state nor any of its agencies has, or ever has had, the power to contract away the policy power of the state, and franchises granted or ordinances passed by cities affecting subjects coming within the power of the state must be considered as having been granted or passed with reference to the power of the state, in the exercise of its police power, to legislate with respect to such matters and subjects, unfettered by the provisions of such franchises and ordinances.

"Economical and efficient operation of public utilities would be impossible unless the state or its delegated agencies have the power, under the police power of the state, to say that further performance of such provision of the franchise is incompatible with the general welfare.

"The ordinance provisions cannot control the action of the Public Service Commission in the face of the general welfare."

Home Rule

The dissatisfaction on the part of those who felt that the state was usurping the powers of the city, gave fresh impetus to the old time demand for home rule for our cities. That cry was not a new one. It was a very natural human protest against the restraints of government, and yet self imposed restraints are of the very essence of self government, and no one of its fundamental principles was better understood than that, by those who planned our present form of government.

The radical, the extreme home ruler, would appear to demand such an absolute divorce of the city from the state, as would enable the city to set up a little oligarchy all its own.

Why such a thing is impossible has already been pointed out.

Self government proceeds upon the theory that the state should do nothing for the individual which the individual can do for himself. Thus has our civilization developed under self government. The opposite of that is paternalism, which believes that the individual should do nothing for himself, which he can get the state to do for him. The advocates of that theory of paternalistic government, have as one of their objectives now, government ownership, which has for its ultimate end, the nationalizing of all business, and municipal ownership is a stepping stone to that end.

Municipal Ownership

We had an opportunity during the late war to see wherein government ownership was incompatible with our scheme of self government. Municipal ownership is equally opposed to the fundamental plan upon which our government rests.

What is said here concerning the vices of municipal ownership, is said with full recognition of the fact that the City of Anderson, which owns its water and light plants, is one of the few outstanding exceptions to the general rule. The City of Anderson, in these two utilities, has a monopoly of the water, light and power service in this city. A general

description of its property and financial status has been placed before you in detail, from which you have seen that it is managed on a business basis, and is as free from the faults common with municipally owned utilities as could reasonably be expected. So, whatever may be the individual opinion of any of us regarding the merits and demerits of municipal ownership, the question in Anderson, is more or less academic, for we all agree that the property is well managed and is a valuable asset to the city, and is rendering a high standard of service, and is free from the vices that so commonly obtain in municipal ownership. So in this city there is no thought of dispensing with these plants. Our anxiety is to be able to maintain the high standard of efficiency that now exists. Having these plants the city must keep them as long as it is able to serve with the degree of efficiency that now obtains.

Speaking with reference to municipal ownership generally, and without regard to our local situation, we must understand that unless a municipality can render a better service to its inhabitants, than can be obtained from private concerns, there is no reason for municipal ownership.

That the theory is inherently weak and in practice a disappointment, becomes evident as we consider that experience demonstrates that in the average municipal plant there is a lack of foresight, or it may be said there exists the political impossibility of exercising foresight, in providing for future growth and adequate reserve. Often municipal plants have neglected to install additional generative capacity until long after there was need for it.

The temptation to make these plants the pawn in the political game of local politics is very great; it is an ever present menace and has often resulted in the absolute failure of certain municipally owned utilities. It is said to be a matter of record that in practically every state in the Union, that municipal operation of public utilities has been found more expensive and less efficient, than under private ownership. In Indiana, it is claimed on creditable authority, that a study of conditions in this state, show that of every one hundred dollars of revenue received by electrical plants in 1920, the privately owned plant spent $79.18 for operating expense, while the municipally owned plants spent on an average of $89.69, a difference of $10.51 on each one hundred dollars in favor of the privately owned plants, in addition to which is to be considered the fact that the privately owned plant was paying taxes, while the municipally owned plant was not.

In Massachusetts, where there is law providing that no municipally owned electrical plant shall sell current for less than cost, a survey was made by an impartial committee, which shows that the cost of manufacturing current in that state was 35 per cent higher in the municipal than in the private plants, and that the distribution costs in the municipal plant were 21 per cent higher, and the labor cost per unit, 53 per cent higher than in the private plants. A striking illustration is afforded by the difference in the power plants at Niagara. We have it from creditable authority, that on the Canadian side, the power plants are government owned, and their rates average a third higher than they do on the American side, where the plants are privately owned.

Every time a utility passes from private to municipal ownership, that property is immediately shifted into the tax exempt class, with the result that the municipality, the county, and the state are deprived of so much tax revenue. A comparison of the tax rate in those cities that own their utilities and those that do not, show that in the former, the average rate on $1,000 is $19.31, while in those cities that do not own the utilities, the average rate is $15.50.

Referring to the statement made a moment ago to the effect that the municipal utilities by paying no taxes, increase the burden of the general tax payer, I want to say on this point, our Anderson utilities are again the exception. They are valued at upward of $1,700,000. At the present rate of taxation, if they were privately owned, they would pay annually for city purposes in taxes, over $14,900; being municipally owned they pay none, but they supply to the city and its inhabitants, without additional expense to the tax payer, electric current for street lighting, worth at the present rate about $30,000 annually, and for which the city would have to levy taxes if it did not own the plant. This is decidedly to the advantage of the city tax payer.

The sad experience of some of the cities in this country that in recent years have embarked on the turbulent sea of

municipally owned street railways, are so well known that comment on that point is quite unnecessary.

Referring to the proposition that municipal ownership is incompatible with our system of government, we all know that the great success of the United States and of American industry has been created by private enterprise and initiative. When we deny to the individual the right to acquire property and possess the rewards of his own genius, we have removed one of the great incentives to human progress and national development. That we do when we nationalize business. We are headed in that direction when we advocate government ownership of railroads. We are taking one of the initial steps when cities embark in municipal ownership.

Our national philosophy has been to hold out to inventive genius and industry, the right to possess the fruits of its own effort. Paternalism is opposed to that. What have we, as a nation, to justify our philosophy? Let us see. During the three hundred years since the first English settlement was made in America, this nation has accumulated the vast aggregate of three hundred billion of national wealth, most of the under our present form of government. England, our nearest rival, has in two thousand years of creative opportunity, accumulated an aggregate wealth of only one hundred seventy billion. Our nation is looked to as a model by all peoples that seek to break away from monarchial rule and establish self government. History furnishes no parallel of national growth, national prosperity, and national achievement like ours. Then, are we not justified in believing that our national philosophy is right, and that those who are today assailing it, are wrong?

If we would have our state function in harmony with the laws which bind it to the Union, it is of the utmost importance that every sub-division and every agency of the state have a care lest they depart too far from the fundamentals of representative free government. The cities are the most important of these sub-divisions, and with them rests the larger share of responsibility for its protectoin. Let us not exchange a philosophy which has made us great, for one that has nothing to its credit but national failure.

HIGHWAY RESEARCH

By A. N. Johnson, Chairman, Highway Research Board of the National Research Council, Washington, D. C.

Before going into details as to highway research, we may take a moment to consider research generally. Research, we are informed by the dictionary, is "the careful or critical inquiry or examination in seeking facts or principles."

The work of the researcher is essentially different from that of the practicing engineer. The engineer plans definitely for a specific purpose or end. The facts and conditions are assembled and known; then the means are devised for executing the work to be done. Not so with the researcher. While sometimes he may have a desired end to attain, often there are no facts or definitely known conditions at hand. There is no precedent from previous experience to guide him. No evidence or fact is too trivial to escape his notice. He may not be at all sure that the plan of investigation upon which he embarks will arrive at a definite port. Again, he may be wholly unaware of the significance or the application of the facts that he as brought to light, but, because of his research, someone, at some time, will make the discovery that these facts are of vital concern to mankind.

Research of this character can be best illustrated by an incident in connection with the work of the German chemist, Nageli, who lived about one hundred years ago. He was studying the reproduction of cells, and for this purpose used a form of algae. He desired to cultivate them in his laboratory which he had improvised in his kitchen. This he was unable to do. The algae, as soon as placed in the water in the laboratory, died for some unexplained reason. After careful observation, he noted that all the algate placed in water drawn from a copper spigot died. Others placed in water not drawn through the spigot lived. He concluded that the minute amount of copper contained in the water caused the death of the algae. Further experiment proved this to be true; and that so small a portion as one part in 50 millions was sufficient to destroy the algae life. But it was not until nearly 75 years later that sanitary engineers made use of this knowledge in the purification of water supplies. It was further discovered that the copper which killed the algae also killed many harmful forms of bacillus

life. Thus, upon the observations recorded by the German chemist 75 years previous, the health of city dwellers, the world over, was protected.

I bring this illustration to emphasize the fact that research work is, of necessity, done on a different basis than the engineering work with which you and I are most familiar.

The value of research work in modern commercial life is evidenced by the fact that so many of the great industries have many millions of dollars invested and spend many thousands yearly in the maintenance of elaborately equipped laboratories in charge of scientists of the widest reputation, to seek facts, to discover new methods or processes, by investigating patiently a thousand different methods in order to arrive at one which may prove practical in commercial and every day activities. So, too, in the great industry of highway transportation, there is equal need and equal value for research.

Seldom has there been experienced in so short a time such a great economic development as we have witnessed in highway transportation. This development has brought into existence thousands of miles of improved highways and millions of vehicles, totaling an annual expenditure of such huge sums that they almost lose meaning for want of a comparison by which they may be measured. For the construction of roads alone, we are spending over a billion dollars a year and several more billions for the manufacture, upkeep and operation of the vehicles. It is not hard to conceive that this should raise a wide variety of problems that call for a great diversity of talent for their study and solution, problems for the economist and the engineer, the physicist and the politician.

The State Highway Department found themselves suddenly called upon to expend millions, where thousands had sufficed. Heavy loads at high speeds had to be carried. Experimental work was undertaken.

In the effort to help to co-ordinate not only investigations that had been undertaken, but to outline the field that was opening for research in the development of highway transportation, the Highway Research Board of the National Research Council was organized, of which Mr. Charles M. Upham is director. Through its effort, there has been fostered increasing active participation by the state universities, where, naturally, much of the work of this character could best be done, provided there was some way to find out what should be done and who could do it.

It is not easy to point, at this early date, specifically to the economic saving that may have been so far effected by these highway researches.

A carefully compiled list of these projects has been made by the Highway Research Board, totaling in number 479, divided as follows:

State Highway Investigations.....	205
University Investigations	184
Municipal, County, Industrial....	90

It is a part of the work of the Highway Research Board to put this mass of information, resulting from these researches, in such form as will impress the public with the material value and necessity of work of this character in the highway field. The fact that, at present, we do not know the exact money value that can be named as the result of these particular researches is not particularly significant. But what is of significance is that there have been programs of research inaugurated in many states that cover a wide field.

Foremost among these are the investigations that have been carried on by the U. S. Bureau of Public Roads, many of which have been in co-operation with the State Highway Departments. The Bureau's investigations into sub-grade conditions, that may be considered as fundamental in the design of our highways, have gone already far enough to point out clearly certain forms of construction that should be followed, and that others on which much had been expended in the past were of small value.

A very interesting economic study has been made in Wisconsin under the direction of the State Highway Department, where it has been learned that tourists in Wisconsin spend yearly, within the state, 80 million dollars, the profit on this amount of business being much more than the state spends on its road system.

As illustrative of the extent to which some of the states have undertaken highway research problems, may be cited what is known as the Bates Test Road in Illinois. This project was carried out by the State Highway Department of Illinois, of which Mr. Clifford Older was chief engineer, in co-operation with the U. S. Bureau of Public Roads, of which Mr. T. H. MacDonald is chief. The state

expended on this experiment $250,000, a large sum for building purely a test structure. One outcome of these tests was a modification of the cross section for concrete roads in the State, lessening the amount of concrete used, while strengthening the road slabs to carry traffic; a saving on the road program, then actually in hand in Illinois, of over two million dollars. This excellent and remarkable piece of highway research work is fully described by Mr. Older in the Proceedings of the A. S. C. E. for February, 1924, page 175.

The extensive series of tests undertaken at Pittsburg, California, is another illustration of the high grade scientific work that is being done in connection with highway research. This investigation was a co-operative effort between the State Highway Commission of California, of which Mr. A. B. Fletcher was State Highway Engineer, and the U. S. Bureau of Public Roads.

For this investigation, there was constructed a track, with parallel sides and circular ends of 75 ft. radius, a total distance of a little over 1,136 ft., on which was concentrated in 89 days over 7 1/3 million tons of traffic. This amount of traffic may be better visualized by the fact that a road with an average distribution of truck traffic of 1,000 trucks per day would require something over 12 years to carry the tonnage applied on the Pittsburg Test Road.

The road itself was of concrete construction of various types, special care being taken to install apparatus that made it possible to observe the effect of traffic upon the road slab. It is impossible in this running summary to do more than to refer those interested to the excellent report of this research issued by the Department of Public Works of California, under the title "Report of Highway Research at Pittsburg, California, 1921-1922." It is significant that many of the phenomena, particularly the curling or vertical movement of the road slab during a change in temperature of the top and bottom of the slabs, noted in the Pittsburg Road Test, are also recorded in the observations made on the Bates Road Test and those made at Arlington, Va., by the Bureau of Public Roads.

In North Carolina, notable work has been done under the guidance of Mr. C. M. Upham, Chief Engineer of the State Highway Commission. After a careful study of what had been done elsewhere, and through building sections of road experimental in character, there has finally been developed a form of road construction suitable for a considerable amount of light traffic, which has a great potential value in the development of many of the poorer and sparsely settled sections of the state. This has been brought about through the development of an inexpensive type of road surface, taking advantage of the sandy character of the soil which prevails in much of the region traversed by these roads.

Investigation and research are needed to study how best to use the highways; what are the proper regulations. First, that we may safeguard life and limb; second, that we may expedite the flow of traffic over the highways. There is no more serious problem before us than that of highway safety. Our highway traffic accidents have reached the appalling yearly total of over 23,000 lives and more than 600,000 persons maimed and injured. We almost ask ourselves if we have not created a Frankenstein.

Probably no more perplexing problem is presented than that of traffic congestion today. We provide radial or arterial roads which concentrate such a large flow of traffic at given points, as of itself to cause stagnation through these centers. We may bring traffic readily and rapidly to the confines of a city, only to discover that there is not traffic area sufficient to take care of the volume that has been so attracted. Eventually, this must cause so great inconvenience as to reduce the amount of traffic. The problem before us is to determine, if possible, what may be the ultimate flow of this highway traffic, and the provisions that should be made for its accommodation. What may very likely happen is the essential readjustment of the distribution of population tending to disperse it rather than continue concentration, as has been the case for so many years, and witnessed by the upbuilding of our great cities.

Perhaps enough has been said to indicate the character and value of research work in general, and in particular that we have many grave and pressing problems in highway transportation that call for co-operation of every available agency. Our universities, wth their splendid equipment of men and laboratories, can probably be used to greater advantage. A very important part of the work of the Highway Research Board will be to

arouse the interest of the various agencies in these problems.

The Highway Research Board also has a number of researches under way which are financed by industrial concerns and there is little doubt but that the program of researches so financed will soon be much enlarged.

This may be expected because the opportunity presented for this character of co-operation, through the organization of the Highway Research Board of the National Research Council, furnishes unique auspices under which such work may be carried on that is scientific in character and impartial in its findings.

The foregoing address by Mr. Johnson was presented before the North Carolina Section of the American Society of Civil Engineers at Asheville.

GARBAGE AND REFUSE DISPOSAL A MATTER OF CLEANSING RATHER THAN HEALTH

By M. N. Baker, Montclair, N. J.

(Editor's Note: Mr. Baker, author of the following paper, read before the American Society of Sanitary Engineering at its latest annual meeting, is Associate Editor of Engineering News-Record and formerly President of the Montclair Board of Health).

Public health and municipal efficiency unite in demanding a functional classification of city activities and the assignment of each to the municipal department best fitted to render the service in question. This is also an essential to budgetary control of municipal finances, which is a factor in municipal efficiency now slowly but surely gaining recognition in progessive American municipalities.

To take the most exalted view of the subject, cleanliness is next to godliness. To take a humbler view, dirt is matter out of place. Whichever view or whether both be taken, the chief end and aim of garbage and refuse disposal is to remove from our dwellings, our yards, our sidewalks, our streets, and, in some instances, from within our cities, a variety of residual or rejected material which, in its original entity, was useful and pleasurable but has become mere waste, matter out of place, awaiting, perchance, restoration to use but at worst to be disposed with the least possible offense and at the lowest possible cost.

Functionally, who can dispute that the collection and disposal of garbage, ashes, waste paper, bottles, tin ware and other metals naturally falls to the public works or engineering rather than to the health department? Even those who see a material health menace in garbage, rubbish, and ashes, must in reason admit that sewerage and sewage disposal have a more, and water supply an infinitely more, vital relation to public health than does the scavenging or cleansing service; yet in not one city out of a thousand is a sewerage system, and in no American city to my knowledge is a water works plant operated by a health department.

Perhaps all who hear or read these words agree with me that, as a matter of municipal administration, garbage and refuse collection and disposal should not be conducted by the health department but some may believe that, nevertheless, the goodness or badness of the service, by whomsoever rendered, vitally affects the public health. Substitute *vaguely* for vitally and I agree. In parts of the country where there is material danger of plague dissemination by rats, I might waive the qualifying word vaguely. I willingly agree also with those who claim that garbage, improperly stored at houses, improperly collected and dumped, attracts flies; and that the assemblage of flies where open privies are also tolerated may spread typhoid and less serious intestinal disturbances. Rarely, in my opinion, would the assemblage of rats and flies, due to garbage, affect the public health to a degree *that could be scientifically reported in terms of vital statistics*, as two or three decades back it was commonly, and as it still is occasionally, possible to measure the effects of a polluted water supply by sharp rises in the typhoid curve.

Since I do not belittle garbage and refuse disposal as a cleansing service and think it probable that most engineers, at least, believe with me that the service should not be under the health department, why, it may be asked, do I persist in urging that the service has little relation to public health? One reason, and perhaps a sufficient one, is because, the country over, most of our city fathers still act upon the assumption that garbage disposal is largely a health matter—when they act at all or adopt what they conceive to be thorough-going measures.

But they act through the emotions, spasmodically, and not in accordance with well informed and reasoned judgment. The emotions, with others as well as city fathers, cannot always be kept at a high pitch. Consequently, garbage and refuse disposal, in most of our cities, has its ups and downs. It is in a continual state of change. Disposal plants, regardless of kind or cost, are no sooner built than abandoned. I strongly believe that one great reason for this is because many of these plants are built in the name of public health and through arousing sentimental emotions. The emotions die; the plant suffers from lack of appropriations and proper management; if not abandoned by the city administration that built it, very likely it will be shut down by its successor. After a bit, another emotional campaign will result in another and like cycle. Many cities have had several of these—and thus collectively have wasted many thousands of dollars.

Coming now to what some may consider the more practical phases of garbage and refuse disposal—whether classed as a health or cleasing service—what are the prime essentials? To go no further than a two-fold classification, I would say they are thorough cleansing and the lowest reasonably possible cost, low cost being essential if appropriations for continuously good services are to be obtained. The first and most important thing is to get garbage and other decomposable material away from house or market before it becomes a nuisance and without creating a nuisance in the removal process, which includes transportation. Prevention of nuisance at the point of origin rests primarily with the householder or storekeeper, through the provision and use of proper containers, and secondly upon the frequency of service rendered by the cleansing department. Covered, water-tight, metal containers fulfill the first condition and collection from once a day to once a week, varying with seasonal and other local conditions, the second.

Wrapping garbage and washing garbage cans are, as a rule, more a matter of local fad and fancy than of good cleansing, and may generally be left to be determined by local sentiment, willingness of householders to take the trouble to wrap garbage, and of taxpayers or householders to stand the extra cost of a two-can service, with transportation of full cans to the point of disposal, washing and returning the cans. I defy any one to prove, in terms of vital statistics and by rules of evidence, that either garbage wrapping or can washing has any effect upon public health. Wrapping interferes with disposal by feeding to hogs or by reduction. The double-can system is obviously more costly than the much more usual and generally satisfactory system of a single and relatively small can, left to the householder to wash according to the sensitiveness of the collective family nostrils.

The sanitary transportation of garbage, after collection, is chiefly a matter of water-tight, covered, metal wagons, which may be washed as often as local conditions demand.

If, as I believe, it is impossible to prove any direct relation between the garbage collection and transportation service and health, it is still more impossible to establish such a relation between final disposal and public health. In either case there is the more or less remote possibility of the sort of health impairment that comes through any material public nuisance, be it offense to eye, ear, or nose. Good cleansing will guard against anything serious of this kind.

The choice between various available methods of final disposal is chiefly a matter of economy but various local conditions may be such that one method of disposal may require a more distant location than another and thus perhaps materially increase the cost of transportation. Taking into account size of town or city, density of population within and without the municipality as bearing upon location of the disposal works, topography, character of soil and use of lands in outskirts or outside the city, market for hogs, fertilizer, etc., and, though rarely under American conditions, possibility of sale of steam or electric power, choice may be made between (1) burial under shallow layers of earth; (2) sanitary fills, which may be of considerable depth, if only the top and as much as may be of the slope is kept covered with ashes or earth; (3) incineration; (4) feeding to hogs; or (5) reduction, for the recovery of grease and tankage. The order in which these five methods is given has no significance. For obvious reasons, earth burial is likely to be available for only relatively small communities, but it might be used for considerably larger ones than usually practice it. The sanitary fill depends more upon topography, accessibility of land that needs filling, etc., than size of

city. Hog feeding has been and may be used for cities of considerable size, as witness Los Angeles today. Reduction is generally considered available only for cities of say 100,000 or more. Incineration is readily adaptable to places of the smallest or the largest size, (theoretically, at least) for the latter by multiplication of plants and consequent reduction of length of haul. I say "theoretically" because recent and current American experience shows much difficulty in locating incinerators in populated districts or even where there are many industrial plants.

If I have already indicated it, let me reiterate that the choice between these and possibly other methods of disposal is not a matter of health, nor of cleansing per se, but of adaptability to local conditions, including relative cost. These questions of adaptability and cost, not forgetting methods of collection and transportation as related to methods of disposal, are engineering questions. Pertaining as they do to collection and to day-by-day disposal operations, they are ever recurring. They can be best and only answered by engineers.

If most of what has been said relates to garbage, it should, nevertheless, be understood that the same line of argument applies also to all other classes of refuse properly dealt with by a cleansing department. The other classes, except dead animals, etc., have even less relation to health than has garbage, but their efficient disposal is likewise work for engineers to direct.

In conclusion, the entire cleansing service, from choice of methods, through design, construction, test, and operation of plant, is engineering in character. It should therefore be entrusted to a city department whose function it is to design, construct and operate public works. That department should include in its staff one or more engineers experienced and competent in garbage and refuse disposal. When it does not include such a man or men, then, until they can be and are found and employed, and from time to time as special problems arise, a consulting engineer versed in these subjects should be employed.

RESURFACING AND WIDENING EXISTING PAVEMENTS

By A. J. Schafmayer, Division Engineer, Board of Local Improvments, City Hall, Chicago, Ill.

(Editor's Note: The following paper was read before the Western Society of Engineers at Chicago in February, 1925.)

Existing traffic conditions have rendered many of our present pavements inadequate or unfit to meet the demands made upon them. The effort to meet these demands and conserve the original investments so far as possible has resulted in a considerable increase in the widening and resurfacing of existing pavements.

Resurfacing Pavements

Resurfacing projects receive a careful analysis before being approved for construction. It is not considered necessary, however, that the same standards of design and endurance should be applied to a resurface project as would be applied to an entirely new paving project. The ordinary resurface pavement is not expected to last as long as a new pavement. We do not expect it to be as well designed as if it were entirely new, whether considered from the standpoint of comfortable and safe riding qualities, surface drainage or appearance. The original improvement is such an essential part of the new one that the new one should properly retain many of the characteristics of the original even though they might not be tolerated in a completely new design. It might very properly be asked—if resurfacing is not completely satisfactory, why consider it at all? The principal reason for considering it is economy. Resurfacing, if physically advisable, will undoubtedly result in a considerable initial economy. The exact amount saved varies of course with the individual conditions. In addition to this lower initial cost there are these further reasons for the property owner desiring to have his pavement resurfaced rather than rebuilt entirely. By postponing new construction ten or twelve years he may take advantage then of new and better types that may be developed. Also there will probably be new economies developed in construction machinery and methods of operation. And there is also a reasonable chance of a reduction in the cost of materials and in freight rates by that time. And finally he may sell his property and let the new owner pay for the more expensive pavement. These reasons explain why the demand for resurfacing is unusually strong at the present time. The initial economy, however, is sufficient to create a popular demand for resurfacing in the majority of cases without any future consideration, so that

the question of resurfacing is usually confined to the physical possibilities.

In considering the physical advisability of resurfacing old pavements in Chicago we have two general cases. 1. Those within two or three miles of Lake Michigan which have a sand sub-grade, and 2. Those lying farther west which have a clay sub-grade. The same methods are used in studying either case. But in studying the advisability of resurfacing old macadam pavements, a greater minimum depth of old macadam is considered necessary in the second case than in the first.

In studying these pavements the old surface or wearing course requires consideration as to its influence on the quantity of material to be removed, or whether it can be retained, in which case it is considered as a part of the base. The old base or foundation should be generally sound, not ravelled or seriously depressed, and should have old replaced cuts and openings in good condition. It should also be of such general depth and cross section that the old base and the new surface can be made to conform to each other. This must be done without disturbing the established curb grade or damaging existing improvements. These last conditions require the greatest study and are freqeuently the cause of the rejection of an otherwise feasible resurfacing project.

The difficulty of successfully conforming the old and the new together lies in the fact that in the earlier days of pavement construction crowns that would now be considered excessive were regularly used. This is especially true of the old water bound macadam type. The problem then, after all other requirements are met, is to place a surface with a comparatively flat crown on a base with a steep crown, keeping the new gutter a proper distance below the established curb grade and at adequate slopes for surface drainage, without removing so much of the old base as to destroy beyond a reasonable limit its capacity for supporting loads. The supporting capacity being a function of the thickness, the minimum remaining thickness is considered as the deciding factor. This minimum thickness is usually set at 7 ins. for case 1 or a sand sub-grade, and at 8 or 9 ins. for case 2 or a clay sub-grade.

Field Surveys

The preliminary work of our studies for resurfacing consists of detailed field surveys. These vary considerably in some features, depending on the kind of material in the old pavement. On surveys for resurfacing old water bound ma-

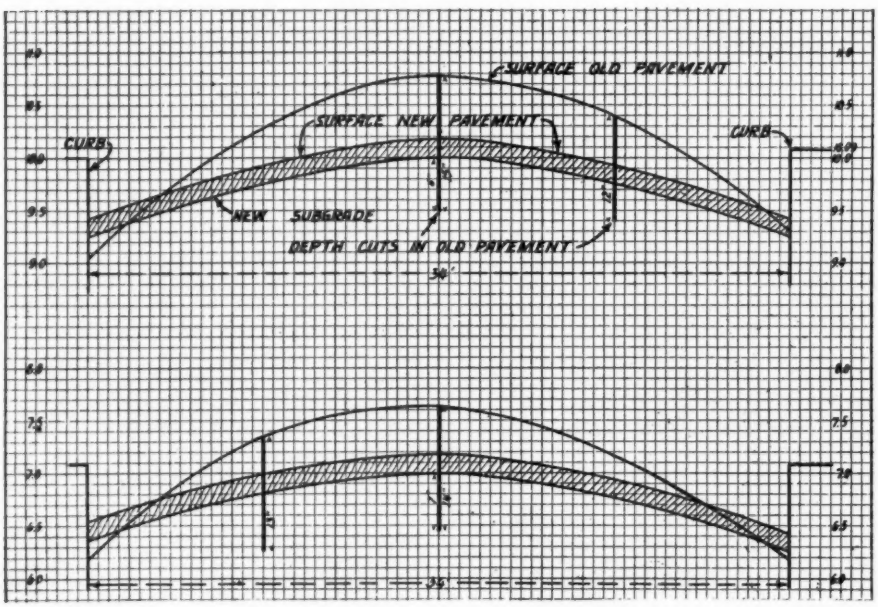


FIG. 1—STUDIES MADE OF OLD PAVEMENTS TO DETERMINE CROSS SECTION FOR NEW WORK.

cadam, which is the most common case, we first make test cuts or depth cuts in the pavement at each summit and inlet, at the crown and quarter points. The cuts are usually staggered back and forth across the street. The inspector records these measurements of depth in these cuts on blank forms, each cut being located by number and distances, and shown in its relative position on a sketch which is part of the form. Notes are also made as to the thickness of the oil mat or surface course if any, and any other pertinent detail such as the base being of the Telford type or of slag, etc. The rigid types such as brick, granite and concrete do not require such extensive cutting, but general depth and nature of base should be known.

The level party makes a survey showing the cross section of the surface of the pavement at each summit and inlet, or break in grade, with readings on the curbs, gutters, quarters and crown. Care is used to have the quarter and crown elevations taken at the location of the test cuts as previously reported.

Office Studies

From this information profiles and cross sections are platted. With the type of wearing surface having been decided upon and its allowable crown, the depth of gutters then determines whether additional material must be added or the old material removed. In the case of macadam pavements, it is usually necessary to remove part of the old pavement, while with the pavements of unit parts such as brick or granite block, additional material is frequently necessary. If the trial design results in a deficiency of material in the old foundation, sometimes a change in the design by shifting summits and inlets, or increasing the crown or raising the entire surface will make it possible to secure the minimum thickness of the old base.

In this connection it is interesting to note that the designer has more latitude or room for adjustment or juggling the

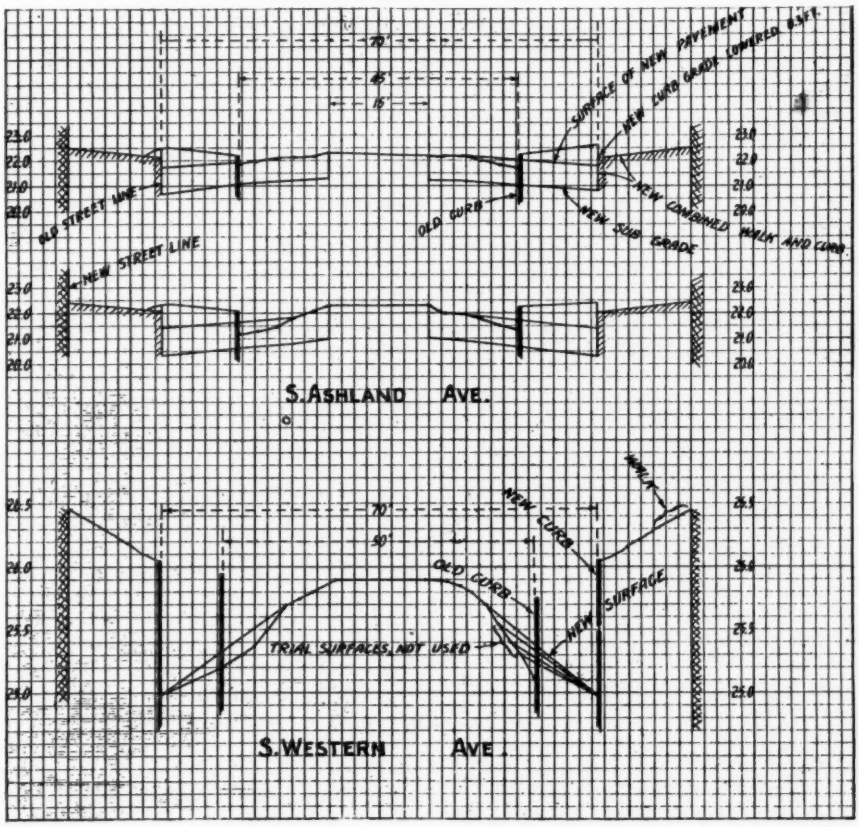


FIG. 2—TYPICAL CROSS SECTIONS MADE FOR STUDYING STREET-WIDENING PROJECTS.

gutters up and down, on the older pavements laid from 20 to 30 years ago, than on the more recent ones laid within the last 15 years. This is probably due in part to a report made in 1904 by John W. Alvord on Chicago Pavements in which he urged the design of pavements with shallower depths of exposed curb face. This recommendation combined with the general tendency of engineers for economy in design has gradually resulted in our modern practice of designing pavements with exceedingly shallow curbs. When such pavements come up for a resurface study about all that can be done is to remove the old surface and replace it with a new one of the same shape. Fortunately, these more recent pavements are generally of such cross section that this can be done.

Where the old pavement has the vertical type of curb without gutters, it has frequently been found advisable to build a new concrete gutter in front of the old curb.

It is worthy of note that there is a growing tendency among paving engineers at present to consider the future resurfacing when designing a new pavement. On brick, concrete and stone block pavements drainage systems are being designed with exposed curb heights ample enough to allow for a new surface to be superimposed without removing any of the original pavement. I have also heard of one city, Champaign, Illinois, George Lohman, city engineer, where provisions have been made in a new street railway franchise for meeting such future resurfaces with the street car rails. In view of our present and probable future paving practices this feature should receive careful consideration from public authorities in preparing new ordinances for street railway franchises or for their extension.

Where old pavements are resurfaced the asphaltic type of wearing surface is generally used. This is a very satisfactory material for resurfacing because it can be laid in a thin course and can be very readily adapted to the various conditions encountered in resurfacing. Any deficiency of material is provided for by a thicker binder, this being a modified black base. This material is also used for filling surface depressions and reshaping certain portions of the original pavement. While it is desirable to lay the binder upon the undisturbed base, still because it is necessary to disturb the existing base by openings for rehabilitating underground utilities, we must provide for considerable repairs to the old base. Such repairs are usually made with the same type of construction as was used in the original base.

The Estimate, Ordinance and Specification

While the studies are worked out in considerable detail these details are summarized in the official estimate in order to avoid new descriptions or phrasings which have not been passed on by the court. So far as possible each item is made identical with or described as nearly parallel as possible, with similar items in our estimates for new construction.

The ordinances necessarily must be more specific than the estimate but in accord with the principle applied in new construction all operations and descriptions are grouped as far as possible and are covered by standard or previously adjudicated descriptions and phrasings. A recent example which presented some difficulties was one system to be resurfaced which consisted of an asphaltic concrete resurface on old macadam part and included a part where the roadway is to be widened 10 feet on each side. The latter required a new base of surplus old material from the balance of the street, black base or binder, and new top. A part required new concrete gutter in front of old sandstone curb. Another, new curb and gutter of standard cross section. Another, new curb and gutter of a special cross section and another curb and gutter patching. Some intersections were excepted. Some were to be widened and adjusted, some to have long radius curb corners in place of sharp curb corners, requiring new pavement and old pavement adjusted; all including the necessary sewer adjustment. These were all reduced to practically standard descriptions and it is confidently expected that no legal attack can be successfully made upon the project on the ground of any deviation or variance from the legally approved forms.

After the assessment has been confirmed in court, specifications are drawn to cover the work in complete detail. The general printed specifications for new work are used as a basis but are modified and amplified extensively to cover the particular improvement.

Construction

Resurfacing of pavements should be done by experienced men. It is the writer's opinion that the supervision of an experienced foreman especially, is more important on resurface work than on

new construction. Inexperienced men make the most deplorable and ridiculous blunders. I had some experience of a green foreman suddenly moving in on a street and attaching rooter plows behind steam rollers and ripping up two blocks of a macadam pavement before he could be stopped. While the contractor then spent an extra week attempting to restore it, it was manifestly impossible to secure the compactness it had received during almost 30 years of traffic. Likewise competent inspectors should supervise resurfacing work and the inspector should have frequent opportunities to consult with the engineer. The numerous irregular developments encountered render this a necessity.

The advantages of resurfacing are: Economy, less disturbance of existing improvements, and less controversy.

Economy

a. The financial economy of resurfacing results from a saving on the pavement per square yard due to the saving of the cost of a new base. This is partly offset by the cost of preparing the old base. There is frequently a saving in the item of curbing. A material saving is usually effected in the item of sewer adjustment and new sewer appurtenances. An important saving is also found in the cost of excavation and the disposal of excavated material.

An economy of time results from the fact that each block is thrown open to traffic as soon as it has been reshaped to receive the surface so that the street is open for use for all but a few days of the construction period.

b. Where a street is resurfaced and the old curbs are used, the old curbs, carriage walks, lawns, drives, sidewalks and intersections all meet and are practically undisturbed. Where a new improvement is made nearly all these require adjustment, due to alignment, settling out of grade, or some other irregularity.

Street	From	To
Western Ave.	Lawrence	Foster Ave.
Western Ave.	56th St.	63rd St.
Western Ave.	63rd St.	71st St.
Ashland Ave.	75th St.	87th St.

c. There is less controversy over resurfacing. The roadway width usually remains the same. There is rarely any argument about narrowing or widening. There is seldom any argument over the type of surface, asphalt being generally acceptable. And finally there is usually less opposition to the improvement in court because the public is strong for resurfacing.

Disadvantages

a. The engineering work is more laborious and more expensive, as previously shown.

b. There are more uncertainties. It is a common thing to have something uncovered that requires a change in the plan or the removal of part of the old pavement and its replacement with new.

c. Old errors in alignment or grade and displacements of existing improvements are continued for a number of years. (This is listed as a disadvantage which it is from the standpoint of the general public or the engineer, but it is not considered as such by the individual affected.)

d. It often continues an old inadequate system of drainage and an obsolete design which should be remodeled and there is an uncertainty as to the strength and durability of the completed improvement.

Widening Pavements

The demand for wider roadways comes in connection with the work of the Chicago Plan Commission, requests of motor and traffic organizations, improvement associations, and the desire of property owners in individual cases.

Roadway widening was formerly considered only when it was found necessary to repave a street. Now, however, owing to the demands created by the tremendous increase in motor traffic it is found necessary to widen pavements which have been in service only a comparatively few years. A few examples are given, as follows:

Year Paved	Material	Old Rdwy.	Year Widened	New Rdwy.
1915	Brick	42 ft.	1923	60 ft.
1915	Brick	50 ft.	1924	70 ft.
1917	Brick	50 ft.	1924	70 ft.
1918	Asphalt	50 ft.	N. of 79th St.	
		42 ft.	S. of 79th St.	
			1924	70 ft.

These are typical examples of pavements with widened roadways which had the old surface utilized to as great an extent as possible. Numerous others have had the roadway widened, or are under proceedings, without attempting to utilize the original surface, but which utilize all or part of the original base. A very interesting example of this type is Ashland Avenue from Devon Avenue to Pratt Avenue which is under proceeding for widening from 30 ft. to 56 ft. Another is Chicago Avenue from Clark Street to Larrabee Avenue. under proceedings to be widened from a 50 ft. to a

70 ft. roadway. This is an old brick pavement laid in 1899. The street railway are below curb grade, while the sidewalks are either at grade or above it. This requires a different design as will be shown later on.

North Clark Street roadway was widened in 1924 from 42 ft. to 94 ft. In this case none of the old brick pavement which was laid in 1908 could be utilized. Other typical examples of projects under proceedings where none of the old pavement can be salvaged, or where only a fractional slab of the old foundation can be used are Indiana Ave., from 15th to 22nd Street and 22nd Street from Calumet Avenue to Archer Avenue. In these cases the street will be widened 54 ft. on one side only and the present 38, 48 and 53 ft. roadways will be widened to 88 ft. For most of their length the street car tracks now in the center of the old street will be moved over to the center of the new street.

Studies for Widening

Very careful surveys are made for aid in studying widening projects. The studies on the north end of Western Avenue were based on roadway cross sections with level readings taken at 1 ft. intervals across the surface. On the section between 56th Street and 71st Street, we used similar cross sections but the readings were spaced 2 ft. apart. On the Ashland Avenue project similar sections were used.

Our sections were taken at each summit and inlet with special and diagonal sections at street intersections. It is also nceessary to note all poles, walks driveways, conduits, buffalo boxes, meters, and basement vaults with coal holes, manholes or trap doors in the portion of the sidewalk or lawn to be occupied by the widened roadway.

Office Studies

These items are platted and studied. The section of the new roadway is applied to the old one. Trial transverse surfaces for the widened portion are drawn in and the most feasible ones chosen. These are then checked for the longitudinal gradients in order to assure proper drainage. The surface is again determined where the gradient is found insufficient. When these surfaces are determined the points of tangency or of intersection of the new surface with the old determine the distance out from the old curbs over which the old pavement must be removed and relaid or replaced. These distances are shown on the contractor's and inspector's working plans and are followed carefully during construction. The sections also show graphically the additional concrete necessary to bring the old base up to its proper contour for the new roadway.

A slightly different method of controlling the distance that the old surface should be removed was used by the engineers on the Ashland Avenue project. Because of numerous irregularities between summits and inlets which would not show on the cross sections the "cut back distance" was not shown on the working plan. Instead the longitudinal gutter slopes were determined and shown on the plan. Then the construction gang used a tight line drawn from the crown to the gutter elevation shown on the plan. The point of tangency with the surface was marked and the surface cut back to that point.

The first method will probably be the more economical in yards of pavement replaced while the second will be likely to give better gradients and slopes and produce a better appearing surface, but will require replacing more old pavement. In either case the new surface will be a series of warped planes rather than warped parabolas or warped cylinders.

Construction

The construction follows the ordinary paving methods. The principal items of any difference to note are these: The importance of cleaning up all debris, filling all ditches and keeping the thoroughfare open, as the old roadway is used constantly while the construction proceeds. The necessity of protecting the workmen from traffic is very important. On streets with such dense traffic that it is necessary to widen the roadway this traffic is a serious danger. The same danger is encountered by the survey parties taking cross sections. Motorists are frequently so reckless and impatient of restraint that it may ultimately be necessary to assign uniformed policemen to protect workmen on such work in a way similar to that of the railroads who send out flagmen to protect their men. An item to check carefully where the surface is brick is the width of the individual brick. It should be equal to that of the original or the courses will soon be out of line or they will not "notch in" to the old surface. A difference of only one-sixteenth of an inch, such as might frequently occur in repressed brick by a slight film of clay or sand adhering to the button part of the mold and thereby

flattening the button on the finished bricks, will cause serious trouble in a project of this type.

Another item of importance on a brick surface and the one where I probably made the most serious mistake on Western Avenue concerns the time when the last two lengths of brick may be removed adjoining the junction line between the undisturbed part and the relaid part of the old pavement. The old bricks should not be removed closer than the length of two bricks from this line until the day the new bricks are to be placed. In this case the fine grading gang ahead of the concrete gang was permitted to remove the old bricks up to the line. The old brick pavement then stood with these ragged edges while the concrete was laid and allowed to set; and in certain portions several weeks elapsed before the new bricks were laid. The pavement all this time was carrying a dense traffic including the heaviest trucks. The pounding and vibration of this traffic loosened or disturbed the old sand bed under the outer bricks to a certain extent. Generally this was not apparent to an observer. In the few cases where displacement was observed the bricks were removed or the sand bed was tamped up under them. In all cases the new pavement was joined flush and smooth with the old surface. However, after a few months of pounding under the traffic numerous places showed a slight settlement of the sand bed under the last brick or two in the old surface. This condition would probably have been avoided if the last two bricks in each row had not been removed until just ahead of the gang laying new brick. Afeer widening, the surface of the old brick was cleaned and then received a top dressing of hot asphalt and torpedo sand.

General

The general design for widening existing roadways followed mainly in Chicago has been that of a crowned roadway with gutters at the curbs. The general design which leaves the old gutter undisturbed and carries the newly widened portion up to the new curb on a rising slope and gives the curb a very shallow exposure has been considered but has not been generally used except on Chicago Avenue from Clark Street to Larrabee Street as previously described, and on the proposed widening of Ogden Avenue from Randolph Street to Roosevelt Road where similar conditions exist. This design has the advantage of being more economical and permits widening a roadway with a low street car track and general surface including gutters, and with high sidewalks, in such a way that the high steps at the curbs are eliminated. There are certain objections to it, however. One is the slight wavy effect it may have on traffic. Another is the objection to having the gutter in the travelled portion of the roadway on account of the unsightliness of accumulations of debris. Also because of the fact that where obstructions form pools by backing up the water these pools are a greater detriment out in the travelled way than adjoining the curb. Another point of influence against this design is the fact that the general appearance of this type of street is not as pleasing as the continuous crown type. However, this type is a practical necessity in such cases as these just described.

A feature of the general design that has been under consideration is that of making the widened part of the pavement of a lighter section than that of the main roadway. It is held that since this strip along the curbs is largely used for standing traffic or parked vehicles such a lighter section would be justified. A detail which has been suggested in this connection, if the design using the original gutter were adopted, has been to build this addition at a slightly higher elevation than the original surface. The connection with the old surface near the gutter would be made with a 2 or 3 in. bevel or short radius curve. This slight rise would serve notice, in a manner, to all drivers that the outer portion is not one of the main traffic lanes. And yet where it would be desirable to turn out for temporary use or for parking the slight rise could be readily mounted by any automobile. While this type offers several obvious advantages it has not as yet been selected for any project by the Board of Local Improvements.

Conclusion

Utilization of old pavements by resurfacing and widening are two phases of highway engineering that are being forced on engineers by the economic and traffic demands. The engineers engaged in the pavement industry have been reluctant to attack these phases of their work because they mean more work and more detailed study for the same output, or a much poorer showing in quantity or results compared with an equal effort expended on new construction. Public authorities while willing to order such

work frequently do not understand why it requires so much more time and effort to produce satisfactory results. The general public has not the slightest idea of the increased work required and does not give it a thought. They simply want the work done right. But the general public, because of traffic conditions, is properly demanding more work of the resurfacing and widening type, and they rightfully expect economy and ability in its design and execution. Furthermore, our more permanent and durable types of pavement foundations which have been common in the last 15 years are inevitably leading us to a constantly increasing volume of such work. The engineers should face it squarely. The decision as to whether the old pavement can be utilized in a new improvement is usually up to the engineer. This is because he is expected to have training, skill and judgment for gathering the facts and figures, and classifying and studying them in their proper relationships to determine the correct method. Everyone knows that half baked projects lead to trouble and bring discredit to a worthy field of construction and to the engineering profession. For these reasons, the engineers should insist on sufficient time and adequate and competent staffs to produce thoroughly worked out studies and plans for either resurfacing or widening projects.

GOOD ROADS PARTNERSHIP

(*From the Minneapolis Tribune*)

In his "drive" for economy, President Coolidge speaks disapprovingly of the joint financing of good roads construction by the federal government and the state governments. He does not seem to care for this kind of cooperation "in principle," but he offers the more practical and obvious objection that it tends to encourage extravagance in public expenditures for roads and so helps to keep the tax burden onerous.

In commending the President for his economy policy it is not necessary to follow him all the way. It is doubtful if the considered judgment of the country sustains him in his position on federal aid for public highways. In many of the states all or a great part of the bill for the construction of state highway systems, in contradistinction from local, or feeder, roads, comes out of the pockets of owners of motor vehicles.

It is surprising how little complaint comes from this group of taxpayers for this purpose. The owners of the 17,000,000 vehicles in the country—if that is the approximate number—desire and must have good roads if they are to gain the maximum of pleasure and profit from their cars, and they are willing to pay for them. For the output they feel that they are largely, if not entirely, requited in savings of time, gasoline and wear and tear on mechanism.

Those who approve of federal and state cooperation in financing good roads have various reasons for the attitude they take. They feel that with the government equity thus established, if we may so speak of it, there is obtained a better articulation of good roads from state to state. This is important not only as a civic asset, but as a consideration of national defense. They believe also that with the government "look-in" there is better assurance that the dollar spent for construction will be made to yield a maximum of good results in roads and service. The opportunities for private profiteering at public expense are minimized. States which accept federal government aid are obligated to see that roads once built are maintained in serviceability.

With land grants and bond issues—the latter for the Pacific railroads—the federal government aided the states in the building of railroads 50 or 60 years ago. It made a mistake in its failure to begin at the outset its regulatory policy, but otherwise federal cooperation in railroad building was an indispensable factor in the facilitation of the development of the country. Important, too, was its effect in the weaving of social and political ties that contributed to nationalism.

It is not necessary that the federal government have the same measure of control or supervision over the interstate highways it helps to build as over the railroads, but the "equity" referred to is a good thing for the country as a whole.

Good roads running from state to state have a substantial civic value. The American people are seeing their own country and making contacts with one another by means of highways in a way that was not possible to them with the aid of railroads alone. Travelers by railroads necessarily stick to tracks and more or less rigid schedules. Travelers by highway have a tremendous latitude for choice both as to route itinerary and the division of time. Good highways and motor vehicles are better popular enlight-

eners than railroad beds and trains. Neighbors used to live one, five or ten miles away. Now they may live 100 or 200 miles away, and fraternizing with them is in the day's run.

It is not so much what we spend for roads, within reason, as what we get for what we spend, and that is enough from the standpoint of the individual citizen or the nation to warrant the federal government's continuance of its good roads partnership for at least some years to come.

PLAYGROUNDS AND CHILD SAFETY

Fatal street accidents to children are much fewer in cities amply supplied with well distributed playgrounds than in cities not so well supplied with these safety zones. This conclusion of the National Safety Council engineers is made public by the Playground and Recreation Association of America, with which the Council is cooperating in its safety campaign.

The investigations of the safety experts in most of the cities cover the three year period 1922-1924 and show that cities with the most playgrounds had from one-third to one-fourth as many child pedestrian fatalities as adult fatalities.

In Cleveland, with a high pedestrian fatality rate, less than 30 percent of the victims were children, according to the study. This city has 72 supervised playgrounds. This low percentage of child fatalities is in marked contrast to the high percentage in an eastern county, where playgrounds are few and poorly distributed.

In Toledo, very few child fatalities were found within normal drawing distance of playground locations. Toledo has twelve playgrounds. The positions of the grounds were plotted on a spot map and circles of a quarter mile and half mile radius were drawn about each to indicate their effective area for the different ages of children. Out of 32 child automobile fatalities during the three years, 1922-1924 inclusive, only four occurred within the quarter mile circles and six in the half mile distance.

In Richmond, which has many playgrounds in proportion to the population, the child automobile fatalities were less than 25% of the total number in which pedestrians were involved. Only twelve children were killed by automobiles in the city during a three year period ending December 21, 1924.

Two hundred thirty-one cities reported 635 new playgrounds last year, according to the Playground and Recreation Association. New athletic fields number 132.

ECONOMIC VALUE OF ROAD REINFORCEMENT

An excellent progress report of the special investigation on the Economic Value of Steel Reinforcement in Concrete Roads was presented by C. A. Hogentogler, Chairman of that investigation, at a recent meeting of the Executive Committee of the Highway Research Board of the National Research Council. Mr. Hogentogler expressed appreciation for the splendid cooperation and assistance received in the course of this study from the various state highway departments and other organizations.

The report showed that inspections have been completed on 375 miles of plain and reinforced concrete roads, varying in age from one to ten years, and containing approximately 300 comparisons of slabs with and without steel which were subjected to the same influencing conditions. These roads are located in Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, Georgia, and Ohio. The states still listed for inspection are Michigan, Illinois, Missouri, Wisconsin, Iowa, Utah, Washington, California, Texas, and Mississippi.

It is thus assured that a sufficient number of direct comparisons will be made to warrant drawing definite conclusions regarding the effect of steel as influenced by age, design, traffic, climate, and subgrade, as well as by the type, weight, and placement of the reinforcement itself. Detailed sketches, designs, and tables are being prepared which will give basic comparisons and a summary of results. Maintenance costs of both plain and reinforced concrete roads have also been secured on a large mileage. These costs are in such detail as to show how the maintenance is influenced by any desired variable.

The final report on this investigation will be one of the most complete studies on concrete roads ever undertaken. It will be presented at the Fifth Annual Meeting of the Highway Research Board

to be held in Washington, D. C., on Dec. 3 and 4, 1925. As a supplementary feature of this report it is expected to have papers presented by representatives of several states which have compiled special information on plain and reinforced concrete roads. It is planned to devote one of the sessions of the Annual Meeting of the Highway Research Board to the discussion of this report.

METHODS OF RATING RIVERS TO BE STANDARDIZED

A joint technical committee is now being organized to bring about national uniformity in the methods of rating the water power of rivers, according to an announcement by the American Engineering Standards Committee, 29 W. 39th St., New York. At the present time a given water power development may be rated at 10,000, 20,000 or 40,000 H. P. by different engineers, according to the point of view from which the work is done by the engineers. For example, the first figure might mean that the power is practically available all the time without provision of any storage basin. The second might mean that this power is available a certain percentage of the time. The last figure might indicate that under certain conditions, as for example if a storage reservoir is provided, the most effective use of the river flow will be achieved when this rate is reached.

At the instance of the Geological Survey, the A E S C made an investigation of the situation and found that many different groups were interested in bringing about national uniformity in the rating of rivers, including light and power companies, financial groups interested in power development, consulting engineers and Federal authorities, such as the Federal Power Commission, Geological Survey, and Reclamation Service. This investigation was carried out by a special investigating committee under the chairmanship of Charles A. Mead, and a questionnaire was sent to all interested technical and industrial groups.

The subject was discussed at length at the World Power Conference held in London in 1924 and the conference recommended that the subject be taken up in the different countries and if possible international agreement be reached upon it.

Statistical data published as the results of various surveys made by competent bodies, giving the amount of potential power resources in different sections of the country are now not always comparable, as the basis for rating rivers varies greatly and the work now being undertaken will supply the need of uniformity in order that the data shall always mean the same thing to engineers, operating companies and investors.

MUNICIPAL BORROWING DECLINES

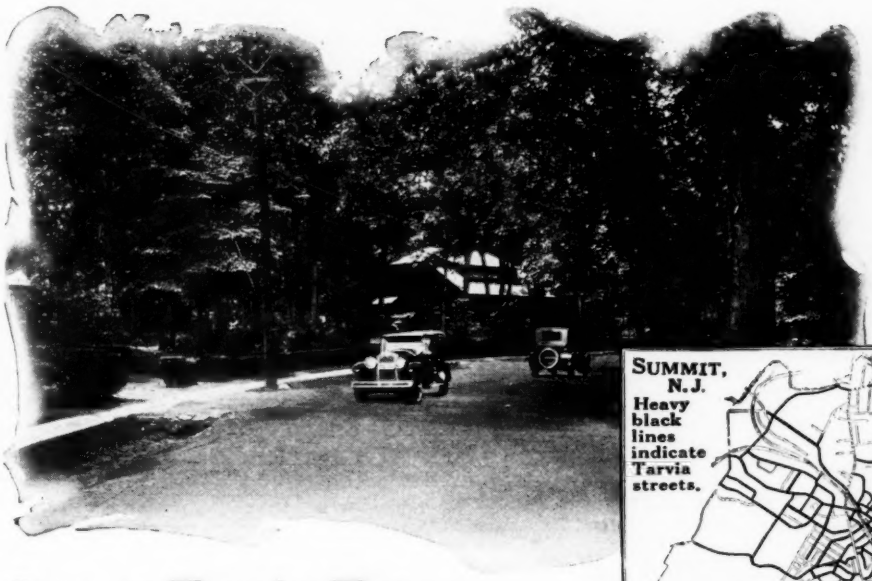
Municipal borrowing generally reaches its peak in May or June. In seven of the past ten years, says The Daily Bond Buyer, June was a bigger month than May with respect to flotations of State and municipal loans, while the May total exceeded that of June in the other three years. In two of these years (1917 and 1920) heavy borrowing continued on into July, in which month the peak was reached.

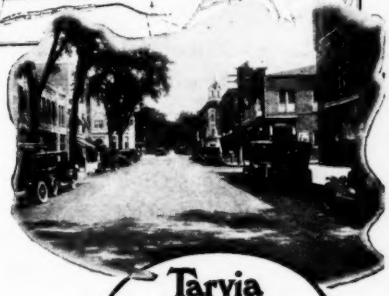
This year May was the big month, bond flotations reaching a total of $185,463,376. A decline in June to $141,241,192 was followed by a further drop in July to $110,612,522. For the seven months of the year to July 31st, the total was $850,545,929, as compared with $943,034,121 in the corresponding period last year.

"It now seems reasonable to assume," says The Daily Bond Buyer, that State and municipal bond flotations reached their peak in 1924 with a total of $1,400,000,000. For several years to come this class of financing should not be greatly in excess of $1,000,000,000 a year."

The following tabulation, compiled by The Daily Bond Buyer of New York, gives the total amount of State and municipal bond issues brought out in July and the seven months ended July 31st for the past ten years:

	July	Seven months ending July 31
1925	$110,612,522	$850,545,929
1924	112,254,665	943,034,121
1923	67,601,722	683,910,342
1922	120,008,165	854,165,441
1921	108,925,459	617,017,761
1920	79,914,826	429,891,817
1919	75,649,360	384,537,802
1918	20,905,646	155,038,730
1917	88,946,592	304,098,265
1916	40,931,309	326,429,929





Once a Tarvia-Town always a Tarvia-Town—

Tarvia Service *Chapter VIII*

HERE'S a significant fact: "Repeat orders make up the bulk of Tarvia business!"

Many cities, towns, states and counties have been steady users of Tarvia over a period of ten to twenty years or more. And in those places we are apt to find the same road officials in office who were "in" when the Tarvia program was inaugurated.

What is the reason for this enduring satisfaction with a Tarvia program? The roads themselves. Many of the old pavements, built in the years when automobiles were snorting novelties, are still in perfect condition today—still as smooth, mudless, dustless and skid-proof as the day they were built.

Note: The experience of hundreds of road officials has proved that only the most economical maintenance is necessary to make a Tarvia pavement last indefinitely.

Summit, New Jersey, is a typical Tarvia-Town. In 1914, Summit first began using Tarvia. Now there are 30 miles of mudless, dustless, all-year Tarvia streets within the city limits.

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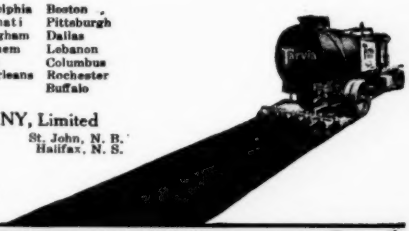
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